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Time of the Weevil

When spring returns to Lombardy and warm sunshine mellows again the pink-washed walls, farmers watch their fields with an anxious eye. To *bieticultori*, spring is the time of the weevil, and in a few days an entire planting of sugar-beet can be devastated, by a pest which attacks both above and below ground.

The sugar-beet weevil, *Temnorrhinus mendicus* Gyll., infests the fields in spring, the adult insects feeding on the young beet leaves : eggs are laid and grubs hatch out to feed greedily on the roots. This double attack, which can reduce the yield by as much as 85%, is serious both for individual farmers and for the great 12 year scheme for the Development of Italian Agriculture now in progress.

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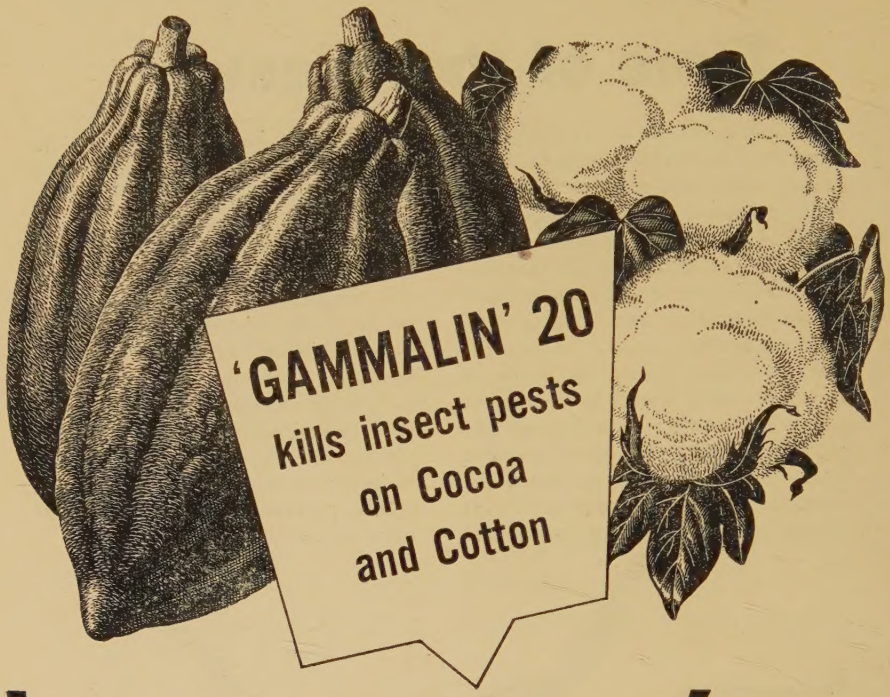

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COMMONWEALTH INSTITUTE OF BIOLOGICAL CONTROL

RETIREMENT OF DR. W. R. THOMPSON, F.R.S., F.R.S. CANADA.

With the retirement at the end of June of Dr. W. R. Thompson, Director of the Commonwealth Institute of Biological Control, entomology in general and biological control in particular suffered a severe loss, which will be especially felt by the staff of that Institute, and by the many entomologists with whom Dr. Thompson has dealt officially.

Prior to joining the staff of the Imperial Institute (then Bureau) of Entomology in 1928, Dr. Thompson had had wide experience in biological control work with the United States Bureau of Entomology. He was an Assistant Director of the Institute, and was Superintendent of its parasite laboratory at Farnham Royal from 1928 to 1939. During these years, extensive work on biological control was done under Dr. Thompson's direction, particularly in Europe, for Canada, Australia and New Zealand.

The outbreak of war in 1939 made work in Europe impossible and Dr. Thompson went to Canada in 1940 to rebuild the organisation, of which he became the Director, and enable it to increase its work. It was at first termed the Imperial Parasite Service, but was raised to the status of an independent Bureau in 1946 and became the Commonwealth Institute of Biological Control in 1951. Its headquarters are in Ottawa, and it has stations in California, Switzerland and Trinidad, together with others, more recently established with funds from the Colombo Plan, in India and Pakistan. The scope of the Institute has expanded considerably during this time, particularly in the tropical field, due to the vigorous efforts of Dr. Thompson.

In addition to this work on practical problems of biological control, Dr. Thompson initiated the production of the *Catalogue of the Parasites and Predators of Insect Pests*, a list, with references, of records from the literature. Some fifteen volumes have already been published.

Dr. Thompson was a pioneer in the field of the mathematical theory of population growth, particularly with regard to parasite populations, and its bearing on biological control. He was elected a Fellow of the Royal Society in 1932 and of the Royal Society of Canada in 1949. His position in the field of entomology in general is well illustrated by the fact that he was invited to be President of the 10th International Congress of Entomology, held at Montreal in 1956.

Since 1942, Dr. Thompson has been editor of the *Canadian Entomologist*, and in addition to his many duties and interests, both entomological and philosophical, he has done extensive research into the taxonomy and systematics of the Tachinids. It is comforting to know that his official retirement will not mean the end of his entomological activities.

Dr. Thompson is succeeded as Director by Dr. F. J. Simmonds, who joined the staff of the Farnham House Laboratory at Farnham Royal in 1939 and has latterly been in charge of the Institute's station in Trinidad.

T. SWAMINATHAN, I.C.S.

Chairman of the Executive Council of the Commonwealth Agricultural Bureaux.

July, 1958.

(2684) Wt. P8508/3923 7/58 E.P. Ltd. Gp. 566. [A] A

Smith (L. C.) & Lohmeyer (V. K.). **DDT-resistant Codling Moth. A Report on the 1955–56 Control Trials.**—*J. Dep. Agric. S. Aust.* **60** no. 4 pp. 185–187, 1 graph, 1 ref. Adelaide, 1956.

Investigations on alternative spray materials for control of the DDT-resistant strain of the codling moth [*Cydia pomonella* (L.)] that has developed on apple in the Paracombe district of South Australia [*cf. R.A.E.*, A **45** 113–114] were continued in 1955–56. The treatments tested comprised 11 applications at fortnightly intervals between 25th October and 13th March of wettable malathion at 0·05 and 0·075 per cent. or of emulsion sprays containing diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] at 0·05 and 0·025 per cent., parathion at 0·025 per cent. or DDT at 0·05 per cent., ten applications between 15th October and 3rd March of 0·025 per cent. diazinon applied one week after the beginning of moth flights as indicated by bait-trap catches, and five applications, the last on 20th December, of micronised phenothiazine at 1 lb. per 100 gals. followed by six of malathion at 0·05 per cent. Infested fallen apples comprised 28 per cent. of the total crop from the trees sprayed with DDT, but not more than 2·7 per cent. of those from trees receiving the other treatments. The percentages of undamaged fruits picked at harvest were 55·7 for DDT, 87·1–93 for diazinon, 95·4 for parathion and 96·4–98 for the treatments including malathion. Ten applications timed by moth flights constituted the best of the diazinon schedules and gave control comparable to that from any of the other effective treatments; it is assumed that sprays of malathion or parathion would be equally effective if timed in the same manner. Infestation was slight up to the end of 1955, but flights were frequent during late January and early February 1956; in a normal season, when, provided effective control is maintained until early January, subsequent flights are small, the number of applications required might be still further reduced. Phenothiazine was not sufficiently effective to warrant further investigation. Of the three phosphorus compounds, malathion and, to some extent, diazinon left troublesome residues, malathion caused most foliage injury and parathion is dangerous to the operators. It is therefore suggested that malathion or diazinon should be used during the first half of the season and parathion during the second.

Hill (E. G.) & Armstrong (M. T.). **Flour Mill Fumigation. A further Report on the Use of Methyl Bromide.**—*Milling* **127** pp. 182–184, 186, 1 graph, 1 ref. Liverpool, 1956.

The flour mill in Britain that was fumigated with methyl bromide at 20 oz. per 1,000 cu. ft. for the control of insect pests in 1952 and 1953 [*R.A.E.*, A **44** 63] did not require retreatment for over a year. It was fumigated for the third time in 1954, methyl bromide being applied at the same rate and by the same technique as before but the exposure period being increased to 48 hours, and the following is based on the authors' summary of the results.

Chemical tests demonstrated that the methyl bromide penetrated rapidly and easily into inaccessible places where cleaning was impossible and where insects (chiefly *Tribolium confusum* Duv.) were breeding. All stages of *T. confusum* used as test insects were killed, and samples of flour and débris collected from various sites within the mill after fumigation were found to contain only dead insects. Incubation at 77°F. for up to ten weeks showed that all eggs, larvae and pupae had been killed, as well as the adults. It is thus concluded that mortality was complete.

Inspection at frequent intervals for two months after fumigation revealed very few living insects. *T. confusum* was first seen on the roller floor after

six months, presumably as a result of introduction with flour returned from the warehouse, and *Anagasta* (*Ephestia*) *kühniella* (Zell.) and *Cryptolestes* (*Laemophloeus*) *turcicus* (Grouv.) also appeared. Their spread within the mill is described, and precautions to prevent reinfestation, which is now the major problem, are suggested.

Andersson (H.). **Undersökningar rörande vanliga fritflugan** *Oscinella frit* **L.** [Investigations on the common Frit Fly, *O. frit.*]—*Sverig. Utsädesfören. Tidskr.* **66** pt. 5 pp. 249–280, 17 figs., 15 refs. Lund, 1956. (With a Summary in English.)

Investigations on the damage caused to oats by *Oscinella frit* (L.) were made in southern Sweden in the summers of 1953–54. All stages of this Chloropid are described, and control measures, which are not very effective, are reviewed. In field observations, adults of the overwintered generation emerged from 20th May and were most numerous in early June, and those of the first generation emerged from 20th June and were commonest in late July; detailed observations were not made on second-generation emergence, but it was proceeding actively in the second week of August. The extent of the damage caused varied greatly with the variety of oats [*cf. R.A.E.*, A **17** 288], and oviposition by the fly was therefore studied in the laboratory. The most favoured sites for oviposition were found to be the coleoptiles, the basal sheath of the secondary shoots and the fold between the base of the leaf and the ligule. Rapid oviposition was evidently dependent on the presence of suitable openings into which the ovipositor could be inserted. The ovipositing female carefully investigated the shoot with the tip of the abdomen, and as resistant varieties were found to have hairy shoots, it was probably irritated by the minute barbs on these. Differences were also found in the coleoptiles, and those of resistant varieties remained in a suitable condition for oviposition for a shorter time than did those of susceptible ones. Resistant varieties were redder in colour than susceptible ones.

Sundby (R.). **The Parasites of** *Phyllocnistis labyrinthella* **Bjerk. and their Relation to the Population Dynamics of the Leaf-miner.**—*Norsk ent. Tidsskr.* suppl. 2, 153 pp., 2 pls., 29 figs., 15 maps, 4½ pp. refs. Oslo, 1957.

The leaf-miner, *Phyllocnistis labyrinthella* (Bjerkander), has caused much injury to aspen [*Populus tremula*] in Norway since 1940, and a study of its parasites was made in 1952–56. These were found to comprise 14 species of Chalcidoids, of which *Epilampsis tadici* Delucchi was the most important. Two of the species were new. The total percentage parasitism varied between about 2 and 50, and *E. tadici* usually accounted for about half of it. The parasites are described, and accounts are given of their bionomics, distribution and alternative hosts and of observations on their population densities and that of *P. labyrinthella*. There was no indication that their importance would increase in the future.

Strokov (V. V.). *Gracilaria syringella* **F. (Lepidoptera, Gracilariidae) and its Control.** [*In Russian.*]—*Rev. Ent. URSS* **35** pt. 4 pp. 789–798, 9 refs. Moscow, 1956.

Gracillaria syringella (F.) is a common pest of lilac (*Syringa vulgaris* and *S. persica*) in the Soviet Union, the larvae mining the leaves and causing them to roll up and appear unsightly. Observations in Leningrad in 1937–39

and in Moscow in 1948 showed that the adults survive for up to a week. Those of the overwintered generation emerge at the end of May, and those of the first generation at the end of July. Pairing, which is repeated, occurs immediately after emergence, and eggs are deposited about 12 hours later, on the lower surface of the leaves, at the rate of 2–12 per leaf, the females laying 60–80 eggs per day and average totals (in field cages) of 164–248, depending on the frequency of pairing. In the laboratory, they laid 157–272 eggs. The larvae hatch in 5–10 days and enter the leaves, forming a common mine. After the third moult, which takes place in about a fortnight, they leave the mine and feed on the surface of the leaf, causing it to curl. About a week later, they pupate in the soil or in the litter around the bushes at depths of 1–2 ins. Adults of the first generation emerge about 18 days later, but pupae of the second generation overwinter. Parasites reared from the pupae comprised *Cirrospilus vittatus* Wlk., *C. pictus* (Nees), *C. elegantissimus* Westw., *Closterocerus trifasciatus* Westw., *Sympiesis sericeicornis* (Nees), *Tetrastichus cyclogaster* (Ratz.), *Pnigalio* (*Eulophus*) *stramineipes* (Thoms.), and *P.* (*E.*) *punctiscuta* (Thoms.). Parasitism was heaviest in the second generation, in which it reached 70–100 per cent. The pupae were also attacked by *Formica rufa* L.

As dispersal takes place only passively (the adults being carried by the wind but not actively flying), control measures are likely to give good results for a long period. The easiest method is to turn over the soil round the bushes to a depth of about 8 ins. when the pupae are present. DDT and BHC dusts gave complete kill of the larvae when applied 3–4 times (at intervals of a day) during each generation. The best time for treatment is when the larvae leave their mines or when they leave the bushes for pupation. The dust should also be applied to the soil round the bushes. In experiments in Moscow in 1948–1949, satisfactory control of the mining larvae was given by sprays of 0·05 per cent. parathion (NIUIF-100), 1 per cent. DDT in oil emulsion or 0·25 per cent. nicotine sulphate with soap.

Paliĭ (V. F.). **An Outbreak of *Laphygma exigua* Hb. (Lepidoptera, Noctuidae) in the Province of Voronezh.** [*In Russian.*]—*Rev. Ent. URSS* **35** pt. 4 pp. 799–802, 9 refs. Moscow, 1956.

Laphygma exigua (Hb.), which is only occasionally numerous in European Russia, was very abundant in 1952 in the Province of Voronezh, and damage was caused to beet, lucerne, and in some places young rye, especially in August. At the end of that month, the larvae pupated in the soil. Those of the next generation were present in September, but mostly died, owing to unfavourable weather. Several insecticides were tested for control, and BHC and DDT dusts proved effective against the younger larvae but less so against older ones. Sodium fluosilicate was also effective against the younger larvae, but calcium arsenate was not sufficiently toxic and barium chloride rather ineffective. In field tests, in which the dusts were applied from aircraft and, in a few cases, from the ground, DDT and BHC killed all larvae in the intermediate instars, but most of those in the later instars survived, although they ceased feeding for a period of at least three days. Sodium fluosilicate and sodium fluoride were again less effective. Observations on the bionomics of *L. exigua* in different seasons showed that there were 2–3 generations a year, the development of the third depending on temperatures in August–September. Their occurrence is described. Hibernation, which usually takes place in the pupal stage, occasionally occurs in the egg and adult stages, although hibernating pupae are more likely to survive the cold. In 1952, adults emerged until the end of October, and since no pupae were left and the adults did not survive the winter, infestation was not observed in 1953.

Vereshchagin (B. V.) & Vereshchagina (V. V.). *Ceresa bubalus* **F. (Cicadoidea, Membracidae) injurious to Orchards in the southern Dniester District.** [*In Russian.*]—*Rev. Ent. URSS* **35** pt. 4 pp. 822–825, 8 refs. Moscow, 1956.

Investigations in Moldavia in 1954 showed damage to fruit trees in two districts by *Ceresa bubalus* (F.), the females of which cut slits in the trunks and branches in which to deposit their eggs. This Membracid had not previously been recorded in the region. It preferred damp orchards, in which the nymphs fed on lucerne and other low-growing plants beneath the trees in spring, and had one generation a year. Other trees were similarly injured, and nymphs were also found feeding on peas, carrots, potatoes, tomatos, cabbage, beet and weeds, but caused little damage. In the orchard, adult emergence began on 7th and oviposition on 16th August, up to five females being observed on individual branches. Eggs were deposited until the end of September, preferably on young trees, but also on the shoots of old ones. No oviposition occurred on dead trees or branches. The slits are about 0·2 inch long and affect both the cambium and the wood; the bark falls off, and in cases of severe infestation, the branches dry up in the following spring. In 1954, the Membracid injured 83·7 per cent. of the trees in an orchard of 44 acres.

No satisfactory control measures are known, but sprays containing 0·22 per cent. DDT, 0·48 per cent. BHC or 0·4 per cent. of a proprietary mixture of parathion and methyl-parathion proved toxic to the newly hatched nymphs.

Godan (D.). **Beiträge zur Autökologie der Veilchenblattrollmücke** (*Dasyneura affinis* **Kieff.**). [Contributions to the Ecology of *D. affinis.*]—*Z. angew. Ent.* **39** pt. 1 pp. 1–19, 8 figs., 27 refs. Berlin, 1956. (With a Summary in English.)

Infestation of cultivated violets (*Viola odorata*) by *Dasyneura affinis* (Kieff.) has increased in Germany since 1950 [*cf. R.A.E.*, A **43** 19] and reaches about 30 per cent. in plantings near Berlin, leading to loss of flower production. Investigations on the bionomics and ecology of this Cecidomyiid were carried out in the latter area, and the following is based partly on the author's summary of the results.

Temperatures of 20–30°C. [68–86°F.] and a relative humidity of 80–95 per cent. were the most favourable for development. The females lived for up to a week in a moist atmosphere, but for not more than three days in a dry one, and laid up to 98 eggs each. Eggs laid in exposed positions on the plant died under dry conditions. Darkness reduced the length of life of the females, the number ovipositing and the number of eggs laid. The larvae hatched in 6–8 days at 20°C., caused the formation of hairy galls on the shoots and leaves and pupated in cocoons in them, the pupal stage lasting 10–12 days. There were four generations a year, adults emerging in the second half of April, late June, the first half of August and late September or early October. The larvae overwinter in the cocoons and are thus exposed to cold and damp. When such cocoons were immersed in water, 61 per cent. of the larvae were still alive after 30 days, and when they were exposed to temperatures ranging from −20 to −23°C. [−4 to −9·4°F.], 57 per cent. were still alive after five days. In 1953–54, 62–86 per cent. of the larvae survived the winter. Parasitism of the overwintering cocoons was low, being 12 per cent. in a planting that had been infested for several years and 3·6–2·7 per cent. in two established only two years previously. The parasites reared were *Ceraphron* (*Calliceras*) *clavatus violae* (Novitzky) [*cf.* **43** 62] and

Platygaster sp. Sunlight favoured infestation, and the numbers of galls on plants in sunny and shaded positions were nine and seven times as great, respectively, at the end of the season as they had been at the beginning of it.

Ensslin (W.). **Die Entwicklungsdauer der Baumwollwanze** *Dysdercus fasciatus* **Sign. (Heteropt. Pyrrhocoridae) in Abhängigkeit von Temperatur und Luftfeuchtigkeit.** [The Duration of Development of *D. fasciatus* in Dependence on Temperature and Humidity.]—*Z. angew. Ent.* **39** pt. 1 pp. 28–33, 3 graphs, 14 refs. Berlin, 1956. (With a Summary in English.)

Dysdercus fasciatus Sign. was reared in the laboratory at constant temperatures of 21 to about 30°C. [69·8 to about 86°F.] and various relative humidities, soaked cotton seeds being provided as food and moistened filter papers as sources of water, and curves are given showing the duration of development of the egg stage and each of the five nymphal instars. The optimum temperature for the development of the fifth instar was about 27°C. [80·6°F.] at 100 per cent. relative humidity, males developing more rapidly than females, and slightly higher at 90 per cent. humidity, but the optima for the egg and the other instars evidently lay above 30°C. Irregularities occurred in some of the curves, the reason for which was not known. A relative humidity as high as 95 per cent. seemed essential for low mortality.

Pschorn-Walcher (H.) & Zwölfer (H.). **The Predator Complex of the White-fir Woolly Aphids (Genus** *Dreyfusia*, **Adelgidae).**—*Z. angew. Ent.* **39** pt. 1 pp. 63–75, 4 figs., 16 refs. Berlin, 1956. (With a Summary in German.)

Since individual populations of *Chermes* (*Dreyfusia*) *piceae* Ratz. and *C. nordmannianae* Eckstein (*D. nüsslini* Börn.) on fir (*Abies alba*) in central Europe show variations in nutritional physiology, bionomics and ecology, the two species are each provisionally subdivided into two ecological forms. These are *C. piceae* form *typica*, an obligatory multivoltine form with wide ecological tolerances living on the trunks of *A. alba* (and on balsam fir (*A. balsamea*) in Canada); *C. piceae* form *aggressiva*, a facultative multivoltine form that infests seedlings, young trees and the trunks of older firs and is morphologically intermediate between typical *C. piceae* and *C. nordmannianae*; *C. nordmannianae* form *typica*, which is mainly univoltine and infests the needles, shoots, branches and trunks of young trees in warm locations; and *C. nordmannianae* form *schneideri* (Börn.), which is also mainly univoltine, occurs on the trunks of old firs [*cf. R.A.E.*, A **17** 639] and is morphologically indistinguishable from the typical form. *C. piceae* is attacked by numerous predators, mainly insects [*cf.* **45** 379, etc.], and *C. nordmannianae* by fewer. A list of the predators is given, showing which are the most abundant, which are less abundant and which only incidental, with their parasites, followed by a table showing the hosts and stages attacked by the most important of them and a discussion of their seasonal occurrence [*cf.* also **46** 200] and effectiveness in controlling *C. piceae*. Activity begins about April, when the overwintered larvae of *Chrysopa ventralis* Curt. and *Leucopis* (*Leucopomyia*) *obscura* Hal. resume development. *L. obscura* differs from all the other predators in having two periods of spring activity, the second occurring in June. Larvae of *Scymnus* (*Pullus*) *impexus* Muls. [**42** 250] hatch in April and are followed at the end

of the month by those of *Laricobius erichsonii* Rosenh. [**42** 280] and *Aphidecta obliterata* (L.) [**42** 199]. *Cremifania nigrocellulata* Czerny [**45** 239], *Cnemodon dreyfusiae* Delucchi & Pschorn-Walcher, *C. latitarsis* Egg. and *Aphidoletes thompsoni* Möhn appear about a week later and are present until late June. All these attack both forms of *Chermes piceae* and one or both of *C. nordmannianae*. There is a further period of activity by *Leucopis*, *Chrysopa*, *Cremifania*, *Cnemodon* and *Aphidoletes* in August–October. Notes are given on the stages in which the various species overwinter. The importance of the predators can be assessed only by long-term investigations, but they are not the only factor concerned in the collapse of outbreaks, overcrowding and climatic influences also playing a part.

Heering (H.). **Zur Biologie, Ökologie und zum Massenwechsel des Buchenprachtkäfers (*Agrilus viridis* L.). I. Teil.** [On the Biology, Ecology, and Changes in Population of *A. viridis*. Part I.]—*Z. angew. Ent.* **38** pt. 3 pp. 249–287, 21 figs. Berlin, 1956. **II. Teil.** [Part II.]—*Op. cit.* **39** pt. 1 pp. 76–114, 11 figs., 3 pp. refs. (With a Summary in English.)

Outbreaks of *Agrilus viridis* (L.), represented by ab. *fagi* (Ratz.), have occurred on beech (*Fagus sylvatica*) in Bavaria of recent years, and investigations on this Buprestid, which was not formerly known as a pest in the region, were carried out in 1952–53. The eggs are laid in masses on the trunks and branches, and the larvae mine beneath the bark, causing die-back. They pupate in cells in the wood. All stages of the beetle, the processes of larval and pupal development and the symptoms of attack are described, its distribution is discussed in relation to climate, and a detailed account is given of observations, partly in the laboratory, on its bionomics. The following is based partly on the author's summary of the results.

Adults of ab. *fagi* reared from beech did not oviposit on deciduous trees other than beech. The thresholds of development for the egg, larva and pupa in the laboratory lay between about 12 and 17°C. [53·6 and 62·6°F.], and outdoor variable temperatures accelerated development. The main flight period occurred in July–August, and the preoviposition period averaged about a fortnight. Eggs were laid only on unhealthy bark, the maximum per female in captivity being 16. The eggs hatched in 5–10 days under the most favourable conditions (a south-west exposure and high temperature). Some of the larvae became full-fed as early as July of the year in which they hatched, though they did not pupate until the following year, but others required up to four years to complete their development. The duration of the pupal stage ranged from 35 days to over three months, depending on temperature.

Severe attack kills weak trees, but in stronger ones the larvae are killed by the flow of sap and the wounds are healed by callus formation. The larvae were attacked by various predators and insect parasites. The parasites comprised several Braconids and Chalcidoids, of which the latter were the more numerous, though none afforded much control. Almost all of the Chalcidoids were Eulophids of the genus *Tetrastichus*. A list of the parasites is given, including those recorded from *A. viridis* in the literature. Investigation carried out for a year on mortality during development showed that this reached 66 per cent. on saplings and 89 per cent. on old trees and was greatest among the first-instar larvae. Following the autumn of 1952, in which abnormally high rainfall occurred after prolonged drought, there was a marked decrease in infestation owing to the increased resistance of the trees.

In tests on chemical control in July–September, beech saplings were

watered with emulsions containing 0·05 per cent. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate] at the rate of about 1 gal. per tree. Observation showed that the percentage mortality of the larvae was 0 in three days, 98 in 30 and 93 in 70 days when the soil was dry, and 84 in 30 days when it was damp. Lower concentrations were much less effective. Spraying the leaves and stems with 0·03 per cent. Systox was of no value, and spraying the bark with preparations containing DDT or γ BHC had no effect on ovipositing adults or newly hatched larvae.

Schmutterer (H.). **Die Grüne Laubheuschrecke** *Tettigonia viridissima* **L., eine Überträgerin des Tabakmosaikvirus. (Vorläufige Mitteilung.)** [*T. viridissima* transmitting Tobacco Mosaic Virus. (Preliminary Communication.)]—*Z. PflKrankh.* **63** pt. 1 pp. 6–9, 1 fig., 3 refs. Stuttgart, 1956. (With a Summary in English.)

As *Melanoplus differentialis* (Thos.) has been shown to transmit the virus of tobacco mosaic in the United States, experiments were carried out in Germany in 1955 to ascertain whether *Tettigonia viridissima* (L.), which occurs in fields of tobacco and other plants there, can also transmit it. Field-collected individuals were kept on tobacco in a greenhouse and transferred for the tests to infected and then singly to healthy tobacco plants on which they were allowed to feed for equal periods varying from five seconds to five minutes. Of the 80 plants infested, 35 became infected, and the rate was not influenced by the duration of the feeding periods. Further tests, in which the insects were allowed to feed on successive healthy plants, showed that their infectiveness decreased rapidly 5–10 minutes after feeding on the source plant and that they could safely be used for fresh tests after 24 hours. As viruses are carried mechanically on the mouthparts of chewing insects, the rapid loss of infectivity was thought to be due to some inactivating substance produced by the mandibular or salivary glands, and a further experiment showed that the addition of saliva from *T. viridissima* to sap expressed from infected tobacco reduced the infectiveness of the latter for healthy plants. *T. viridissima* is not likely to be of much importance as a vector of tobacco mosaic, as it is never abundant in the field and the virus does not persist in it.

Pitcher (R. S.). **The Biology of the Black Currant Leaf Midge** *Dasyneura tetensi* **(Rübs.) in Relation to the Planning of Control Measures.**—*45th Rep. E. Malling Res. Sta. 1957* pp. 136–139, 2 figs., 7 refs. East Malling, 1958.

Dasyneura tetensi (Rübs.), the bionomics of which are briefly described, has become an important pest of black currant in south-eastern England [*cf. R.A.E.*, A **30** 327]. It can be controlled in nurseries, in which the damage is the most severe, by frequent applications of parathion or a similar insecticide, but the use of such compounds is undesirable in fruiting plantations, and DDT, which is commonly used as an alternative, has given inconsistent results. Investigations were therefore made on a single variety at East Malling in 1947–53 with a view to improving control. The observations showed that the date of first egg deposition varied greatly from year to year. Although the first eggs were usually laid within a few days of full flower, they were laid about two weeks earlier, coinciding with the grape stage, in 1949, and they did not appear until about two weeks after full flower in 1951. Counts of eggs and larvae in growing tips in 1948,

1949 and 1951 showed that seasonal development differed from year to year. In the cool summer of 1948, a large third and an appreciable fourth generation occurred, whereas in the hot, dry summer of 1949 there was only a small third and no fourth generation, and in 1951, the first two generations did not occur until June and July, owing to the late spring, and the third and fourth were severely limited by a hot, dry period in late July.

In tests on control, a wettable-powder spray of 0·1 per cent. DDT was applied in each year as nearly before or after the first oviposition as possible and was supplemented in some cases by a further treatment about a fortnight later and usually by treatment of the soil around the bushes. An emulsion spray of 0·01 per cent. parathion was also tested in 1951–52. It was applied as soon as the first curled leaves were seen and sometimes again about ten days later. The results were assessed by recording the proportions of shoots curled by larvae of the first and second generations, and comparison of the best results for the second generation showed that control reaching 66 per cent. was given by either material only in 1951. Timing was evidently not the most important factor, as it was rather inaccurate in that year, and in 1952, when it was optimum, control was only 18 per cent. for both materials.

It is concluded that the erratic results obtained in these tests and in commercial treatment are due to difficulties in predicting adult emergence in spring and in providing and maintaining an effective insecticide deposit on the foliage to prevent oviposition or control the eggs and larvae. An insecticide suitable for these purposes has not yet been found, and it is suggested that a systemic toxicant might give better results. In the meantime, foliage sprays should be supplemented by soil treatment against the newly emerged adults and applied at least a week before the usual date of first emergence (late April or early May) and again two weeks later if necessary.

Muir (R. C.). **On the Application of the Capture-recapture Method to an Orchard Population of** *Blepharidopterus angulatus* **(Fall.) (Hemiptera-Heteroptera, Miridae).**—*45th Rep. E. Malling Res. Sta. 1957* pp. 140–147, 16 refs. East Malling, 1958.

A population of the Mirid, *Blepharidopterus angulatus* (Fall.), which is one of the most important predators of fruit-tree pests [*cf. R.A.E.*, A **41** 39], was studied in an apple orchard in southern England in 1955 by means of the capture-recapture method [*cf.* B **22** 12]. This involves releasing a known number of marked individuals into an unknown population, with which they freely mingle, and determining the proportion of marked individuals in a subsequent sample. The total number released divided by the proportion of marked ones subsequently found provides an estimate of the total population, and changes through hatching, death or dispersal can be taken into account by adopting a programme of repeated catches and releases.

A plot consisting of ten bush trees in two rows in a planting of about a thousand similar trees was selected, and adults of *B. angulatus* were jarred from the trees, taken to the laboratory and marked with three spots of oil paint of various colours to permit subsequent identification. After the appropriate records had been made, the insects were returned to the trees from which they had been taken. The process was repeated twice a week from 18th August to 29th September, all recaptures being recorded. The results were analysed to determine the influence of sex, age and recapture on survival, and as it was found that males were less likely to be recaptured than females, data for the two sexes were recorded separately. The likelihood of recaptures was not affected by previous marking and release, by age,

or by repeated handling. The results, which are given in tables, were analysed by a method devised by G. M. Jolly to show not only the population estimates for the various dates, but also the daily wastage rates (due to death or emigration) and daily dilution rates (due to adult emergence or immigration).

It is concluded that the method is applicable to the study of *B. angulatus*, and that its application to two populations concurrently would give valuable information on the response of the predator to different levels of prey abundance.

Stuckenberg (B. R.). **The immature Stages of** *Merodon bombiformis* **Hull, a potential Pest of Bulbs in South Africa (Diptera: Syrphidae).**—*J. ent. Soc. S. Afr.* **19** no. 2 pp. 219–224, 5 figs., 5 refs. Pretoria, 1956.

Adult Syrphids reared from larvae found feeding on corms of *Gladiolus* sp. in Natal in 1955 were identified as *Merodon bombiformis* Hull, the third-instar larva and puparium of which are described. A very slight infestation had been observed in 1953. In 1955, damage was first noticed in mid-September, when 5–15 per cent. of the corms were affected. Those examined had been extensively excavated by the larvae and the tunnels were filled with rotting vegetable matter. Unidentified mites, probably scavengers, were also present. The source of the infestation was not known. This appears to be the first record of such damage by *Merodon* in South Africa, though adults of *M. equestris* (F.) have been reared there from bulbs imported from Europe.

Smithers (C. N.). **On** *Philopsyche abdominalis* **Morley (Hym.: Ichneumonidae), a Parasite of** *Acanthopsyche junodi* **Heylaerts (Lep.: Psychidae).**—*J. ent. Soc. S. Afr.* **19** no. 2 pp. 225–249, 5 figs., 3 refs. Pretoria, 1956. **Corrective Note.**—[1] p., 3 refs., multigraph. Salisbury, S. Rhod. [1957.]

Charitopimpla sericata (Krchb.) (*Philopsyche abdominalis* Morl.) is the commonest parasite of *Kotochalia* (*Acanthopsyche*) *junodi* (Heyl.) on wattle (*Acacia mollissima*) in plantations in South Africa. An account is given of the bionomics of this Ichneumonid, together with descriptions of all stages. The life-cycle is completed in about six weeks, and there may be up to five overlapping generations a year, the full-fed larvae of the last overwintering in the bags made by the host larvae. The larvae of the parasite feed externally and develop only on those of *K. junodi*; the adult females also feed on, and completely consume, the contents of larvae of *K. junodi* and of a Tortricid that occurs on the trees, and both sexes imbibe various fluids. Females survive for up to three months, but males for a much shorter period. Females are about twice as numerous as males and laid up to 31 eggs each. Adult emergence begins in September, about the time when the host eggs are hatching, but females containing mature eggs were not present till 25th October and larvae were not found attacking the young hosts for a further 11 days. No parasites or predators of *C. sericata* were found, but the larvae were attacked by a fungus and a virus disease; parasite larvae on hosts infected with wilt disease soon died. In plantations in which the percentage infestation by *K. junodi* in January–February averaged 4·7 and 7·9, percentage parasitism ranged from 1·3 to 9·1 and from 2·9 to 17·4, respectively. Fungus and virus diseases of *K. junodi* are more prevalent

where host populations are high, but since the incidence of *C. scricata* also increased under these conditions, the parasite is of potential importance as an alternative control agent.

Bedford (E. C. G.). **The automatic Collection of mass-reared Parasites into Consignment Boxes, using two Light Sources.**—*J. ent. Soc. S. Afr.* **19** no. 2 pp. 342–353, 2 pls., 4 figs., 6 refs. Pretoria, 1956.

Chelonus texanus Cress. was introduced into South Africa, reared in the laboratory on *Anagasta* (*Ephestia*) *kühniella* (Zell.) and liberated in large numbers in 1942–52 against *Loxostege frustalis* (Zell.) [on *Pentzia*] in the Karroo [*cf. R.A.E.*, A **38** 160, etc.], but failed to withstand the rigorous climate of the area and did not become established. The collecting device here described was developed for use during the laboratory rearing in 1951–52 and enabled up to 333,000 adults to be collected automatically in a month. A large glass funnel, 9 ins. in diameter, is fitted into a board covering a window in the room and leads into a collecting box. Below it is an organdie screen covering two fluorescent lighting tubes. The rearing boxes are stacked in concentric semicircles facing the funnel and staggered so that those in the front row do not obscure the exits of those in the back row. The emerging parasites fly to the illuminated screen and crawl from it, attracted by daylight, through the funnel into the collecting box, which is replaced when some 3,000 have entered. The box is then prepared for consignment. The method has the advantage that the insects are not handled or subject to mechanical injury.

Dürr (H. J. R.). **The Morphology and Bionomics of the European Houseborer, *Hylotrupes bajulus* (Coleoptera: Cerambycidae).**—*Ent. Mem. Dep. Agric. S. Afr.* **4** pt. 1, [4+] 136 pp., 3 pls., 56 figs., 3 graphs, 6½ pp. refs. Pretoria, 1956.

All stages of *Hylotrupes bajulus* (L.) are described in detail (pp. 1–65), and an account is given of laboratory studies of some aspects of its bionomics in western Cape Province, South Africa [*cf. R.A.E.*, A **44** 285]. At room temperatures of 21–23°C. [69·8–73·4°F.], eggs hatched at relative humidities ranging from 10 to 100 per cent., but few or none hatched at 37°C. (98·6°F.), regardless of humidity, and none at 11°C. (51·8°F.) and relative humidities of 10 or 90 per cent. [*cf.* **25** 499]. Maximum hatching took place at 90 per cent. relative humidity, though the percentage was nearly as high at 65 per cent., both at room temperature. When eggs were exposed under iron and tiled roofs at 65 per cent. relative humidity, 39 and 87 per cent. hatched, respectively [*cf.* **44** 285]. Larvae survived at room temperature (about 60°F.) and relative humidity (60–70 per cent.) in blocks of pine sapwood of which the moisture content after 357 days was 10·44 per cent., but not at temperatures and humidities that permitted the moisture content of the blocks to fall to 6·45 per cent. or lower or to reach or exceed 14·27 per cent. over the same period [*cf.* **25** 500; **33** 18; **40** 14]. The combined larval and pupal stages under room conditions lasted from about 1¾ to over 5 years, with an average of nearly three years [*cf.* **34** 12]; it was 182 days shorter in *Pinus radiata* (*insignis*) than in *P. pinaster*, and 537 days shorter in very recently felled wood than in seasoned timber. Rates of development and growth both varied considerably among larvae from eggs of the same batch. Since the larvae in many blocks of *P. radiata* failed to develop, though others in *P. pinaster* kept under the same conditions, and in *P.*

radiata in previous seasons, developed readily, wood from favourable and unfavourable blocks was examined chemically and microscopically. The content of spring wood in the annual rings of the unfavourable samples was 18 per cent. less than in the favourable ones, and the annual rings of the former were slightly larger in diameter and contained slightly more lignin in the autumn wood than did the favourable ones; the unsuitable wood also had lower mineral and protein contents. Larvae throve in processed pine timber under cover, in which the moisture content, after two years, averaged 11·53 per cent., and were also found developing in a wooden box in a garage in which the moisture content was 7·54 per cent. [*cf.* **26** 195] and in roof timbers and tree stumps in the field in which it ranged at the time of analysis (summer) from 8·35 to 10·81 per cent. The larvae absorbed atmospheric moisture at relative humidities of 98·2 or 100 per cent., but lost moisture rapidly at relative humidities of 95 per cent. or below. At room temperature, some pupal development occurred and a few adults emerged at 10 and 35 per cent. relative humidity. In the field, pupation occurred only in spring or summer. In the laboratory, peak emergence took place between mid-December and mid-January. Males and females survived for average periods of 8·92 and 16·37 days. The females laid an average of 119·4 eggs, with maxima of 563 and 439, and appeared to be more fecund than they are in Europe [*cf.* **23** 155, 197; **25** 499; **31** 121]; 48 per cent. laid over 100 and 5·9 per cent. over 300 eggs. At 52°F., they failed to oviposit, but survived longer than at room temperatures. Some females oviposited at 98°F., but they laid fewer eggs, and the survival period was considerably reduced. Adults did not feed in the laboratory, though fertile eggs were laid, but evidence was obtained that they do so in the field.

Albrecht (F. O.). **Limitation des effectifs chez un acridien: influence de la sécheresse du sol sur les oeufs de** *Nomadacris septemfasciata* (**Serv.**). —*Locusta* no. 4 pp. 1–21, 4 graphs, 20 refs. Nogent-sur-Marne, 1956. (With a Summary in English.)

Preliminary investigations of the influence of soil moisture, acting through the eggs, on population fluctuations in *Nomadacris septemfasciata* (Serv.) were made between November 1952 and January 1953 in an important oviposition area in the middle of the Rukwa Valley, Tanganyika. The first rains broke on 10th–13th November, but, apart from light showers on 24th and 25th November and 4th December, no further rain fell until 1st and 2nd January, and the moisture content of the soil during the period under consideration did not exceed 5·05 per cent.; the relative humidity of the air reached maxima of 70–100 per cent. by night and minima of 30–50 per cent. by day, and maximum day and minimum night temperatures were 30–36°C. [86–96·8°F.] and 17–22°C. [62·6–71·6°F.], respectively. The locusts were scattered and reached a density of 25 per 100 paces over only one square kilometre in the experimental area. Numbers remained constant until the end of December and then fell rapidly owing to high mortality; males were slightly, and in the latter part of December considerably, more numerous than females. The oviposition cycle was determined in samples of females that were collected regularly and classified according to the maximum length of the eggs in the ovarioles. Sexual maturation was attained simultaneously throughout the population a few days after the first rains, and the subsequent oviposition activities of the females were also synchronised, enabling the frequency of oviposition of the whole population to be assessed. The first egg-pods were laid over a period of 16–20 days, beginning on 19th November, and almost 55 per cent. of the females had

oviposited six days later. Although some females were ready to deposit their second egg-pods by 28th November, very few had done so by 9th December. The percentage ready to oviposit had then increased to 60 per cent., and it remained constant for a further eight days, so that most of the females were evidently able to retain their egg-pods for at least 8–10 days, doing so possibly because of the unfavourable dry conditions. The third egg-pods were deposited during 3rd–9th January, after the resumption of the rains, but fewer than half of the original number of females oviposited a third time, owing to the decline in the population.

Examination of egg-pods at intervals showed that the embryos could not long withstand desiccation and that under the prevailing dry conditions few reached the stage of blastokinesis, which occurs about the tenth day of development. The egg stage lasts 30–31 days in the Rukwa Valley, and it required 20–21 days at 32°C. [89·6°F.] in the laboratory [*cf. R.A.E.*, A **41** 236], though no hatching occurred unless the soil had been kept moist during the whole of that period. It is estimated that all the first egg-pods and 50 per cent. of the second were destroyed by the drought, and that only eggs deposited within ten days of the resumption of the rains survived. These findings were confirmed by the date of appearance of newly hatched hoppers, which were first noted on 20th January. Egg mortality was in reality higher than the estimate indicated, since pods in which only some of the eggs were dead were not taken into account. There were sufficient survivors to indicate a considerable population in 1953, but the observed population in that year was light, and other mortality factors, including the possibly unfavourable effects on the hoppers of lack of moisture during incubation, were evidently in operation.

Choudhuri (J. S. B.). **Experimental Studies on the Selection of Oviposition Sites by** *Locusta migratoria migratorioides* **(R. & F.).**—*Locusta* no. 4 pp. 23–34, 6 graphs, 8 refs. Nogent-sur-Marne, 1956. (With a Summary in French.)

The soil conditions preferred by females of *Locusta migratoria migratorioides* (R. & F.) for oviposition were investigated with gravid females in the gregarious phase in cages at constant conditions of 35°C. [95°F.] and 75 per cent. relative humidity. In preliminary tests in which the locusts were offered a choice between road gravel, clay, sawdust and various types of sand, all of which had been dried and then moistened with equal amounts of water, most egg-pods (about 28 and 26 per cent., respectively) were laid in clay and sharp sand, in both of which holes that maintained their form could be readily made. These types of soil and road gravel were more compact and remained wetter than the other materials, but oviposition in the gravel was largely prevented by the mechanical obstruction caused by the stones. The colour of the medium appeared not to affect selection. Further tests with sand showed that particle size, pH value and the combined effects of particle size, moisture content and degree of compaction had no significant influence, but moisture content and degree of compaction considered alone had significant effects. Moist or very moist sand was preferred for oviposition, but no egg-pods were laid in sodden sand, which, however, contained most empty holes. When the surface of the sand was heated to temperatures in the range of 26–45°C. [78·8–113°F.], most egg-pods were laid at 36–38°C. [96·8–100·4°F.]. The author points out that temperature may not in itself be limiting, but that it may affect the humidity over the soil, and that the heavy oviposition in warm soil may be the outcome of the attractiveness of the latter to basking adults.

Report of the Cocoa Conference held at Grosvenor House, London, W.1., 10th to 12th September 1957.—xiv + 326 pp., 28 pls. (15 col.), 1 col. fldg. map (in pocket), text illus., refs. London, Cocoa, Choc. Confect. Alliance, 1958.

The papers read at this Conference include four dealing with insect pests of cacao, abstracts of which appear below.

Lavabre (E.). **Notes on Insect Pests of Cocoa in the French Cameroons** (pp. 105–106 and in French pp. 106–108). The main insect pests of cacao in the French Cameroons are Mirids. *Sahlbergella singularis* Hagl. is injurious and widespread, whereas *Distantiella theobroma* (Dist.) is rare and *Helopeltis bergrothi* Reut. not injurious, though common. The population generally increases considerably between July–August and December–January. DDT was formerly applied for control, but has been replaced by mist sprays of γ BHC. Of the minor pests recorded, *Achaea catocaloides* Gn. is the most important, the larvae dropping sporadically from the shade trees and feeding on the leaves of the cacao.

Hammond (P. S.). **Notes on the Progress of Pest and Disease Control in Ghana** (pp. 110–118, 7 col. pls.). This paper includes an account of work in Ghana on the control of Mirids [*S. singularis* and *D. theobroma*] on mature cacao by means of mist sprays of γ BHC carried out in 1954–56 and of the progress of the two spraying schemes initiated as a result of it [*cf. R.A.E.*, A **46** 209–210].

Donald (R. G.). **A Capsid Control Experiment in the Western Region of Nigeria** (pp. 119–124, 1 col. pl.). This account of an experiment in western Nigeria in 1956–1957 on the control of Mirids [*D. theobroma*] on cacao by means of mist sprays is similar to one already noticed, but the insecticide is erroneously cited as BHC instead of γ BHC [*cf.* **46** 212].

Taylor (D. J.). **Pest Control Research at W.A.C.R.I.** (pp. 125–128). Details are given of investigations in Ghana in 1956–57 in which endrin, γ BHC, aldrin, dieldrin and heptachlor were compared in mist sprays for the control of Mirids [*S. singularis* and *D. theobroma*] on cacao and dieldrin was found effective for control of the ants that foster the mealybug vectors of the swollen-shoot virus [*cf.* **46** 211].

Mehrotra (K. N.) & Smallman (B. N.). **Ovicidal Action of Organophosphorus Insecticides.**—*Nature* **180** no. 4576 pp. 97–98, 7 refs. London, 1957.

Organic phosphorus insecticides are thought to exert their toxic effect by inhibiting the acetylcholinesterase of the nervous system, but it is known that they are toxic to insect eggs when applied before the nervous system is differentiated [*cf. R.A.E.*, A **39** 427] and that eggs treated with them develop normally up to the point of hatching and then die [*cf.* **46** 51, etc.]. Since their ultimate toxic effect is presumably due to an abnormal concentration of acetylcholine, the content of this substance and the cholinesterase activity in normal eggs of *Musca domestica* L. were compared with those in eggs exposed, within an hour of deposition, for one hour on filter paper treated with 2 per cent. parathion in acetone. At 28°C. [82·4°F.], eggs of *M. domestica* normally hatch in 12 hours, and the assays were made on eggs 1–11 hours old. The treated eggs developed normally to the point of hatching, but larvae did not emerge from them. Acetylcholine and cholinesterase activity were not apparent in either normal or treated eggs during the first five hours of development, but acetylcholine was detected in both at nine hours; the content was then 5 and 7 μg. per g., respectively, but two hours later it had increased to 490 and 742 μg. Cholinesterase activity, which was first detected in normal eggs at seven hours and increased in

intensity up to the time of hatching, was completely inhibited in the treated ones. The delayed action of anticholinesterases on insect eggs can therefore be explained by the absence of acetylcholine during the early stages of development and the inhibition of cholinesterase at the time of hatching, when large quantities of acetylcholine have accumulated.

Steinhaus (E. A.) & Smith (R. F.). Ed. **Annual Review of Entomology. Volume 3.**—9 × 6 ins., viii + 520 pp., illus., many refs. Palo Alto, Cal., Annual Reviews, Inc., 1958.

The reviews in this third volume of a series [*cf. R.A.E.*, A **45** 70, 137] comprise: **The Nervous System,** by K. D. Roeder (pp. 1–18, 105 refs.); **Chemoreception in Arthropods,** by E. S. Hodgson (pp. 19–36, 1 fig., 75 refs.); **Internal Symbiosis in Insects,** by A. G. Richards & M. A. Brooks (pp. 37–56, 83 refs.); **Nutritional Requirements of Phytophagous Insects,** by W. G. Friend (pp. 57–74, 118 refs.); **Recent Advances in Silkworm Nutrition,** by J. M. Legay (pp. 75–86, 1 graph, 84 refs.); **Uses of Sounds by Insects,** by H. Frings & M. Frings (pp. 87–106, 137 refs.); **Dynamics of Insect Populations,** by A. J. Nicholson (pp. 107–136, 27 refs.), in which the author summarises the evidence for the existence and universal operation of density-governing reaction in population control, examines criticisms levelled against this view [*cf.* **45** 71] and discusses alternative mechanisms that have been suggested; **Ovarian Structure and Vitellogenesis in Insects,** by P. F. Bonhag (pp. 137–160, 8 figs., 104 refs.); **Genetics and Breeding of the Honey Bee,** by W. C. Rothenbuhler (pp. 161–180, 2 figs., 129 refs.); **The Phylogeny of the Panorpoid Orders,** by H. E. Hinton (pp. 181–206, 64 refs.); **Zoogeography of Insects,** by J. L. Gressitt (pp. 207–230, 209 refs.); **Hybridization and Speciation in Mosquitoes,** by L. E. Rozeboom & J. B. Kitzmiller (pp. 231–248, 64 refs.); **The Feeding Habits of Biting Flies and their Significance in Classification,** by J. A. Downes (pp. 249–266, 139 refs.); **Resistance of Plants to Insects,** by R. H. Painter (pp. 267–290, 198 refs.), which is a survey of information subsequent to that reviewed in the author's well-known book on the subject [**40** 370]; **Biological Control of Insect Pests,** by C. P. Clausen (pp. 291–310, 119 refs.); **Biology of Scarabaeidae,** by P. O. Ritcher (pp. 311–334, 174 refs.); **Insect Eradication Programs,** by W. L. Popham & D. G. Hall (pp. 335–354, 2 figs., 6 maps, 9 refs.), which is essentially a review of work in the United States; **The Chemistry and Action of Acaricides,** by R. B. March (pp. 355–376, 151 refs.), who deals mainly with materials toxic to phytophagous mites; **Organic Phosphorus Insecticides for Control of Field Crop Insects,** by W. A. L. David (pp. 377–400, 184 refs.); **Insecticides for Control of Adult Diptera,** by R. W. Fay & J. W. Kilpatrick (pp. 401–420, 153 refs.), which is concerned with species of medical or veterinary importance; **Forage Insects and their Control,** by G. G. Gyrisco (pp. 421–448, 285 refs.), which is based mainly on work in the United States; **Control of Forest Insects,** by R. E. Balch (pp. 449–468, 134 refs.); and **Transmission of Plant Viruses by Arthropods,** by K. M. Smith (pp. 469–482, 62 refs.).

Palmer (T. P.). **Resistance of Swedes to Aphids. II. Distribution of Aphids on Swedes.**—*N.Z. J. Sci. Tech.* **38** (A) no. 1 pp. 30–33, 4 refs. Wellington, N.Z., 1956.

In this second part of a series [*cf. R.A.E.*, A **42** 335], the results are given of counts, made in New Zealand, of *Brevicoryne brassicae* (L.) on a resistant and a susceptible variety of swede in 1951 and of this Aphid and *Myzus persicae* (Sulz.) on the resistant variety and two other varieties, one resistant and the other susceptible, in 1953. In general, they confirmed

previous findings that Aphids are more numerous on susceptible than on resistant varieties [*cf.* **43** 233]. In 1951, *B. brassicae* was most abundant on the young leaves of both varieties and absent or rare on the oldest ones [*cf.* **39** 79], and the difference between numbers on leaves of different ages was greater than that between the varieties. On the resistant variety, most apterae occurred on the two youngest leaves, particularly the first, but they were abundant on the 4–5 youngest leaves of the susceptible one. The leaves of resistant varieties evidently become resistant at an earlier stage than those of susceptible ones. In 1953, the relative abundance of *B. brassicae* on resistant and susceptible varieties and on leaves of different ages was similar to that observed in 1951, but whereas *M. persicae* was less numerous on one of the resistant varieties than on the susceptible one, numbers on the latter and on the other resistant variety were about equal. This Aphid was about twice as numerous on the four oldest leaves of each variety as on the four youngest, but its density (assessed as the number per g. of green leaf) on young leaves was 5–10 times that on old ones; *B. brassicae* was 30–40 times as dense on young as on old leaves.

Fry (P. R.) & Jacks (H.). **Effect of foliar and Soil Applications of Insecticides on Control of Aphids and Turnip-mosaic Virus on Swedes.**—*N.Z. J. Sci. Tech.* **38** (A) no. 2 pp. 120–123, 1 ref. Wellington, N.Z., 1956.

In further tests on organic phosphorus insecticides for the control of Aphids, chiefly *Myzus persicae* (Sulz.), on swedes in New Zealand [*cf. R.A.E.*, A **43** 346], apterae of *M. persicae* were placed on plants in pots two, seven and up to 16 days after the latter had been sprayed with 0·025 per cent. lindane [almost pure γ BHC] or 0·024 per cent. parathion. Only those placed on the plants two days after spraying failed to survive. In a field test begun on 21st March 1955, seedling swedes in the cotyledon stage were sprayed weekly or fortnightly with these two materials, weekly with TEPP [tetraethyl pyrophosphate] at 0·025 per cent., or weekly or at intervals of three weeks with 0·35 per cent. schradan or a combined spray of schradan and TEPP. In addition, schradan was applied to the soil prior to thinning at 20 fl. oz. per 4½ ft. of row and subsequently at 4 fl. oz. per plant at intervals of one, two or three weeks. The Aphids present were apterae and occasional alates of *M. persicae* and alates and apterae of *Brevicoryne brassicae* (L.), but they were not sufficiently abundant to cause obvious plant damage. All the treatments significantly reduced populations, the least satisfactory being three-weekly applications of schradan with TEPP, which reduced numbers from 955 to 115 per 16 plants, and the best being weekly applications of schradan to the soil, which reduced them to four. Weekly sprays of γ BHC, parathion and schradan alone or with TEPP and schradan applied fortnightly to the soil all reduced the numbers to about 11 per plant and were significantly superior to weekly applications of TEPP or fortnightly or three-weekly applications of the other sprays. All treatments caused a significant reduction in the incidence of turnip-mosaic virus, which still, however, infected some 30–60 per cent. of the plants; weekly applications of parathion gave the best disease control and reduced incidence from 94·5 to 33 per cent. This treatment was the only one that caused a significant increase in the weight of the plants at the 1 per cent. level, and weekly applications of schradan, fortnightly applications of γ BHC, and three-weekly applications of schradan with TEPP were significantly inferior to it. At the 5 per cent. level, a significant increase in weight followed weekly applications of TEPP, fortnightly applications of parathion, and three-weekly applications of schradan, all as sprays, and weekly or fortnightly applications of schradan to the soil. Significant correlations were found

between Aphid numbers and virus incidence and between virus incidence and plant weight.

Doull (K. M.). **Thrips infesting Cocksfoot in New Zealand. I. The Thrips Fauna of a Cocksfoot Seed Crop.**—*N.Z. J. Sci. Tech.* 38 (A) no. 1 pp. 52–55, 6 refs. Wellington, N.Z., 1956. **II. The Biology and economic Importance of the Cocksfoot Thrips** *Chirothrips manicatus* **Haliday.**—*T. c.* pp. 56–65, 3 refs. **III. The Identity of two Species of** *Chirothrips*.—*T. c.* no. 4 pp. 431–433, 2 figs., 3 refs.

Thrips infesting cocksfoot (*Dactylis glomerata*) in New Zealand were investigated in 1953–55 at Lincoln, South Island, since it was thought that they might be responsible for the low seed yields commonly obtained. A list of the species found, with notes on their abundance and possible injuriousness, is given in the first paper. The only one shown to be of importance in reducing the seed yield was a species referred to in the first two papers as *Chirothrips manicatus* Hal., but stated to be *C. pallidicornis* Priesn. in the third, in which characters are given differentiating the adults of it and the true *C. manicatus*; the latter breeds on meadow foxtail (*Alopecurus pratensis*) and occurred only rarely on *D. glomerata*. Two other thrips, *Aptinothrips rufus* (Gmel.), which was common, and *Anaphothrips obscurus* Müll., may also cause some loss of seed by feeding on the florets. Both adults and nymphs of *Aptinothrips* occurred on the inflorescences before flowering, and floral parts with which they were associated were often withered and deformed. *Anaphothrips* was less numerous and occurred later in the year.

Field and laboratory observations on the bionomics of *C. pallidicornis* are described in the second paper. Populations on the shoots and inflorescences were most numerous during the hottest part of the day and varied considerably from day to day with temperature and sunlight; at flowering time, they were of the order of 20 per inflorescence. Overwintered females were first observed in mid-September each year, but they were not numerous until late September or early October, when they were usually found inside the young unrolling leaves or the sheaths of the outside leaves. Later, they occurred on the developing inflorescences. Eggs were first observed in mid-November on wild cocksfoot, which flowers earlier than the cultivated strains. The eggs were laid, usually singly, near the top of the developing ovule; two or three florets in one spikelet were more often infested than single florets in different spikelets. The nymphs hatched in about 5–7 days and fed on the ovules, which they completely destroy, each nymph attacking only one. Prepupae and pupae were found in florets of wild cocksfoot in the first week in December and in those of cultivated cocksfoot a week or two later; adults were present on wild plants in the second week of December. On emerging, the apterous males crawl to florets containing females, where mating presumably takes place. Examination in June 1955 of seed heads from wild and cultivated plants collected in the previous December established that the males leave the florets and die, while the mated females overwinter in the dead florets. Many florets, especially on wild plants, remain on the dead stalks, and these and others that fall into the centre of the plant provide conditions suitable for overwintering. Florets that fell to the ground and remained wet for some time and others stored under completely dry conditions were usually found to contain only dead thrips. Some evidence was obtained of a partial second generation in the year on wild plants, on which all stages were present in small numbers at the end of December. No evidence of breeding on plants other than *D. glomerata* was obtained, though adults were observed on other

grasses and clover, and are able to feed on ryegrass (*Lolium perenne*). The two sexes appeared to be equal in numbers, and counts of the overwintered females in florets in June 1955 indicated that the percentage of seeds destroyed as a result of infestation was 30·2 in one field and 47·8 in another; some of the flower heads in the latter were sprayed weekly until December 1954, when flowering ceased, with 0·5 per cent. wettable p,p′DDT, and the percentage of seeds destroyed on these was only 2·4. The corresponding percentages of good seed were 9·5, 9·4 and 20·5, respectively, and the low yield obtained from the sprayed florets, despite the good control given by the DDT, is attributed to the hot, dry weather that prevailed in the previous spring and early summer. A decline in yield usually occurs 2–3 years after the establishment of a crop, and this is commonly attributed to poor agronomic conditions, but it may be caused by increasing thrips populations.

Infestation is likely to be heavier on wild cocksfoot than on cultivated crops, in which the flowering period is shorter and from which many thrips are removed at harvest. The usual method of harvesting the seed is to thresh the crop from the stook, and the straw and most of the débris is subsequently burned. Following threshing in this manner, most of the thrips were found to have been removed, but the remainder would provide a source of subsequent infestation. Recommended preventive measures comprise, in addition to care at harvesting, the destruction of seed heads on wild cocksfoot in late summer and autumn. The use of insecticides appears promising, but further investigations are needed to determine whether it would be economically practicable.

Sturgess (O. W.). **Leaf shrivelling Virus Diseases of the Tomato.**—*Qd J. agric. Sci.* **13** no. 4 pp. 175–220, 17 figs., 34 refs.; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 97, 46 pp., 17 figs., 34 refs. Brisbane, 1956.

Tomatos in south-eastern Queensland have over the past ten years been attacked by three closely related virus diseases differing in symptoms from any already known. Field and glasshouse tests in 1953–54 established that one of them, known locally as tomato leaf shrivel, was caused by a leaf-shrivelling strain of potato virus Y, and the other two, referred to as tomato yellow shrivel and tomato fern-leaf shrivel, by combinations of this virus with the aucuba strain of the tomato mosaic virus and the cucumber mosaic virus, respectively. The symptoms of all three are described. Tomato leaf shrivel is widespread each year from late autumn to spring. It spreads rapidly through the crop, often causing 100 per cent. infection, and seriously affects fruit production. Investigations on transmission showed that the virus is transmitted by mechanical inoculation and by grafting. *Aphis gossypii* Glov. was the commonest Aphid found on the plants in late autumn and early winter, but *Myzus persicae* (Sulz.) and *Macrosiphum solanifolii* (Ashm.), which were present in smaller numbers, were the only Aphids capable of efficient colonisation in cage tests. In glasshouse experiments, the virus was transmitted from infected to healthy plants readily by *Myzus persicae*, less readily by *Macrosiphum solanifolii*, and occasionally by *A. gossypii*, at temperatures below 80°F., but *Myzus* failed to transmit at higher temperatures. The dissemination of the disease appeared to be largely due to the movements of Aphid vectors, though mechanical transference during cultural operations contributed to some extent. In experimental plots sprayed regularly to prevent Aphid infestation, the spread of the disease was considerably retarded and the yield was increased by over 60 per cent. Field investigations indicated that the other two diseases are also transmitted by Aphids.

Hooper (G. H. S.). **Potato Broad Mite and its Control.**—*Qd J. agric. Sci.* **13** no. 4 pp. 244–245; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 98, 2 pp. Brisbane, 1956.

Hemitarsonemus latus (Banks) has been present on potato in Queensland for many years and caused considerable damage to crops in parts of the Lockyer and Fassifern Valleys in 1955 and 1956. In experiments on control, treatments were applied during the fourth week of March 1955 and the first in April 1956, when damage had already occurred, and the results were assessed from counts of the mites surviving on samples of leaflets taken at intervals of up to 13 days. Sprays of lime-sulphur (1:80), wettable sulphur (3 lb. per 100 gals.) or 0·05 per cent. dieldrin reduced populations considerably, but did not give effective control.

Hartzell (A.). **Red Pine Scale with special Reference to its Host Plants and Coldhardiness.**—*Contr. Boyce Thompson Inst.* **18** no. 10 pp. 421–428, 2 figs., 4 refs. Yonkers, N. Y., 1957.

The author briefly describes all stages, the distribution and the bionomics of *Matsucoccus resinosae* Bean & Godwin on red pine (*Pinus resinosa*) in Connecticut and New York [*cf. R.A.E.*, A **44** 274], and gives the results of preliminary experiments already noticed on its food-plant range, carried out in an arboretum in New York [**44** 317]. Further observations there on 30th October 1956 showed that infestation had spread naturally to another Japanese red pine (*P. densiflora*), four trees of *P. densiflora* var. *umbraculifera* and one of *P. tabulaeformis*. Predators observed feeding on the Coccid on *P. resinosa* included *Coccinella transversoguttata* Fald., *Cleis picta* (Rand.), *Xenotracheliella inimica* Drake & Harris, a Dipterous larva and several species of spiders, but they were not abundant enough to effect appreciable control. In experiments on *P. resinosa* under controlled conditions. exposure to temperatures between −10 and −29°F. for 4–7 hours killed over 90 per cent. of the overwintering stages of *M. resinosae* and repeated exposure to −10°F. killed 99 per cent., and it is therefore concluded that the spread of infestation to the north is likely to be retarded.

Morofsky (W. F.), Guyer (G. E.) & Lemmien (W.). **Chemical Control of the European Pine Shoot Moth in southwestern Michigan. (A preliminary Report.)**—*Quart. Bull. Mich. agric. Exp. Sta.* **39** no. 2 pp. 236–240, 1 ref. East Lansing, Mich., 1956.

Rhyacionia buoliana (Schiff.), which was recorded in Michigan for the first time in 1930 [*R.A.E.*, A **19** 221], has since spread to many plantations of red pine [*Pinus resinosa*] in the southern part of the State. With a view to the timing of control measures, infested buds collected in 15 counties in May 1954 were kept at 75°F. for records of adult emergence. The results showed considerable variation with district, emergence beginning between 14th June and 21st July and continuing for 1–10 days. Tests on control were carried out in two localities in 1954–55, the materials used being sprays containing 1·5 U.S. pints 19·5 per cent. endrin emulsion concentrate, 2 lb. 25 per cent. wettable diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 1 U.S. gal. of an emulsion concentrate containing 48 per cent. Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate], 6 lb. 50 per cent. wettable DDT and 3 lb. of the last alone or with the addition of 3 lb. 25 per cent. wettable lindane [almost pure γ BHC], all per 100 U.S. gals., and a dust containing 5 per cent. DDT. In the first locality, new shoots on trees averaging 4·5 ft. in height in a small plantation were

sprayed with the mixture of DDT and γ BHC on 15th June 1954, when the adults were flying, and observation in May 1955 showed that the trees had been almost completely protected from infestation. In further tests in the same locality in 1955, new growth on four-foot trees was dusted or sprayed on 8th–10th June, during adult flight, and examination in October indicated that the mean percentage of trees infested had decreased to 37 and 1 for 3 and 6 lb. 50 per cent. DDT, 78 for the DDT dust and 2 for the mixture of DDT and γ BHC, as compared with 90, 82, 93 and 73 before treatment. In the second locality in 1955, nearly all buds above a height of 4 ft. on trees averaging 7·5 ft. in height were found to be infested on 17th May, before adult emergence, and sprays were applied at about 250 U.S. gals. per acre when 65 per cent. of the adults had emerged. Adults remained numerous for a further three weeks, and the percentages of lateral and (in brackets) terminal buds infested on 1st September averaged 25 (90) and 22 (6) in two plots treated with 3 lb. 50 per cent. DDT, 95 (100) for endrin, 52 (100) for diazinon and 47 (90) for Thimet. It was evident that such heavy infestation as occurred at this last locality would require two applications. The cost of the treatments during 1955 in the first locality is discussed.

Cagle (L. R.). **Life History of the Spider Mite *Tetranychus atlanticus* McGregor.**—*Tech. Bull. Va agric. Exp. Sta.* no. 124, 22 pp., 9 figs., 9 refs. Blacksburg, Va., 1956.

Tetranychus atlanticus McG. is one of the most important pests of strawberry in south-eastern Virginia [*cf. R.A.E.*, A **41** 352], caused serious injury there to clover in 1950 and has also been recorded from other plants. As little was known of its bionomics, investigations were made in the insectary, and to some extent in the field in 1952 and 1954, and the following is based on the author's summary of the results.

T. atlanticus, all stages of which are described, feeds on a wide range of plants, but is commonest on low-growing ones; clover was used in the tests. Both sexes paired readily with adults of other species, but no fertilisation occurred. The adult females overwintered, and there appeared to be 14 generations in 1952 and 15 in 1954, but calculations based on the relation between temperature and development indicated 16 generations in 1954. Oviposition occurred from late March to mid-November in 1952 and from early March to 21st December in 1954, females laying up to 230 eggs each. The duration of the egg stage ranged from two days at 81·1°F. to 32 days at 50·6°F. Both males and females passed through a larval and two nymphal stages, the larval stage lasting 1–13 days and the protonymphal and deutonymphal stages 1–14 and 1–37 days, respectively, and total development required 3–51 days, depending on temperature. The preoviposition period, maximum oviposition period and maximum length of life of the females were 1–6, 78 and 89 days, respectively, and males lived for 7–65 days. Some two-thirds of the progeny of females that had been caged with males were female, whereas only males were reared from eggs laid by unfertilised females.

Cutright (C. R.). **A Three-year Field Study of a Mite Population resistant to Parathion.**—*Res. Circ. Ohio agric. Exp. Sta.* no. 37, 12 pp. Wooster, Ohio, 1956.

In an apple orchard in northern Ohio that had received 2–4 applications of 0·5–1·5 lb. 15 per cent. wettable parathion per 100 U.S. gals. each year for several years, this compound failed to give good control of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) in 1952 and early 1953, the mite having

apparently developed resistance to it. Two applications of sprays containing Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] or parathion were made later in 1953 and resulted in populations of 0·1, 1·3 and 23 mites per leaf on 31st July, respectively, and full-scale experiments on the effectiveness of various acaricides were therefore carried out in 1954–55. The results showed that sprays of 0·5 lb. 50 per cent. wettable ovex [p-chlorophenyl p-chlorobenzenesulphonate], 1·5 lb. 15 per cent. wettable Aramite, 1 lb. 25 per cent. wettable Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] and 1 U.S. pint of an emulsion concentrate containing 25 per cent. Dimite [1,1-bis(p-chlorophenyl)ethanol] per 100 U.S. gals. gave adequate control, as also did two systemic toxicants, demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] and Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate], at low dosages in emulsion sprays, but Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] and glyodin [2-heptadecyl glyoxalidine acetate] were unsatisfactory. On trees on which parathion had not been used in 1953 or 1954, it gave good results in early 1955, indicating that resistance had declined, but its effectiveness decreased again rapidly after several applications, particularly when low doses were used; replacing parathion for one season only had no effect on resistance.

Of several new acaricides tested in 1955, 1 lb. 25 per cent. wettable F.W.293 [1,1-bis(p-chlorophenyl)-2,2,2-trichloroethanol], 1 lb. Stauffer R-1303 [O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate (Trithion)] and 1·5 lb. 25 per cent. wettable AC-528 [2,3-p-dioxandithiol S,S-bis(O,O-diethyl phosphorodithioate)] appeared promising, but wettable Niagara 908 (a copper complex of an organic phosphorodithioate) and 7744 [1-naphthyl N-methylcarbamate (Sevin)] did not.

Boudreaux (H. B.). **Revision of the Two-spotted Spider Mite (Acarina, Tetranychidae) Complex,** *Tetranychus telarius* **(Linnaeus).**—*Ann. ent. Soc. Amer.* **49** no. 1 pp. 43–48, 13 figs., 13 refs. Washington, D. C., 1956.

The author recognises three species within the complex of *Tetranychus telarius* (L.) as defined by Pritchard & Baker [*R.A.E.*, A **44** 19–20]. These are *T. telarius*, *T. cinnabarinus* (Boisd.), of which the synonyms include *T. multisetis* McG. and perhaps *T. cucurbitacearum* (Sayed), specimens of which were not seen [*cf.* **44** 20], and *T. lobosus*, sp.n. The first two are polyphagous and cosmopolitan, and the third is recorded from cotton and other plants in Louisiana and has also been collected on *Wistaria* in North Carolina. The eggs, summer females and males of all three are described. *T. telarius* has white or cream-coloured eggs and the summer females are usually green in basic colour, the eggs of *T. cinnabarinus* always have a trace of red and the summer females are carmine in basic colour on all the body behind the eyes, and the eggs of *T. lobosus* are whitish when laid by fertilised females and reddish when laid by unfertilised ones, and the summer females deep carmine. There are other differences in the females, but the males are all very similar.

The validity of the three species was confirmed by the results of cross-breeding experiments [*cf.* **44** 20], which were based on the fact that female Tetranychids that have not paired produce males only, and those that have paired both males (from unfertilised eggs) and females (from fertilised ones), except in a few species in which males are never produced. In 22 reciprocal crosses of *T. telarius* with *T. cinnabarinus*, 636 males and 263 hybrid females were produced. The latter were a pale pinkish red in colour, fed little and

lived for twice as long as the normal life-span of either parent species. Of 164 observed, only four laid eggs [*cf.* also **46** 58] and males hatched from nine of these, although the four females had paired with one or more of the males. In tests with four of the nine males so produced, one sired 23 female offspring, none of which oviposited, one sired four females, of which one laid eight sterile eggs, and two sired no female progeny. In eight crosses of *T. telarius* with *T. lobosus*, 321 males and one female were produced; the latter died before it could be tested. In eight attempts to cross *T. cinnabarinus* with *T. lobosus*, only males were produced.

Beck (S. D.). **The European Corn Borer, *Pyrausta nubilalis* (Hubn.), and its principal Host Plant. I. Orientation and Feeding Behavior of the Larva on the Corn Plant.**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 552–558, 30 refs. Washington, D. C., 1957. **II. The Influence of nutritional Factors on larval Establishment and Development on the Corn Plant.**—*T. c.* pp. 582–588, 42 refs.

In the first of these two parts of a series, an account is given of laboratory investigations on the major factors influencing the initial orientation and subsequent feeding habits of the larvae of *Pyrausta nubilalis* (Hb.) on maize plants. The results largely confirmed existing information, and the following is based on the author's summary of them. The orientation and feeding behaviour of the larvae can be explained by negative phototaxis and positive thigmotaxis and the fact that, in the positions chosen, they tend to feed mainly on the tissues containing the highest levels of sugar (positive saccharotrophism). Chemical attractants appear to have no effect in determining the feeding sites, but the physical characteristics of the tissues have at least a minor influence on feeding behaviour in the early instars.

The following is based on the author's summary of the second part. Experiments on the nutrition and feeding response of newly hatched larvae of *P. nubilalis* on purified diets that were lacking in various components failed to show that nutritional deficiencies in the plant tissues are responsible for the high mortality observed among larvae feeding on the leaves of maize seedlings. The requirement for sugar (glucose) was negligible during the early stages of larval growth, but high during the later stages, whereas that for protein (casein) was high during early growth and low later. These requirements are well correlated with the feeding behaviour of the larvae on maize.

Beal jr. (R. S.). **Synopsis of the economic Species of *Trogoderma* occurring in the United States with Description of a new Species (Coleoptera: Dermestidae).**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 559–566, 9 figs., 10 refs. Washington, D. C., 1957.

In view of the recent introduction of *Trogoderma granarium* Everts into the United States [*cf. R.A.E.*, A **44** 445, etc.], the author gives revised keys to the adults and to the larvae (so far as known) of the Nearctic species of the genus and information on the synonymy, geographical distribution, food-preferences and other aspects of the bionomics of ten that are of actual or potential economic importance in the United States. Of these, one described as *T. boron* Beal in a paper previously noticed [**44** 64] is considered identical with the Palaearctic *T. glabrum* (Hbst.), which occurs in granaries, and another, misidentified as *T. glabrum* in the same paper, is described from the adults of both sexes as *T. teukton*, sp.n. It was found in silk in Minnesota and attacking whole wheat from North Dakota.

T. inclusum Lec., which was formerly synonymised with *T. versicolor* (Creutz.), is considered to be a distinct species [*cf.* **44** 85]. It occurs in Britain and the United States, and *T. versicolor* in continental Europe. Characters differentiating *T. inclusum* and *T. versicolor* are described.

Hay (C. J.). **Experimental Crossing of Mountain Pine Beetle with Black Hills Beetle.**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 567–571, 1 fig., 7 refs. Washington, D. C., 1957.

Dendroctonus monticolae Hopk. (mountain pine beetle) cannot with certainty be distinguished from *D. ponderosae* Hopk. (Black Hills beetle) by morphological characters, habits or life-history, and is usually separated from it on the basis of geographical distribution, food-plants and adult size. *D. monticolae* has been recorded over large areas in the northern and western United States, and *D. ponderosae* in the south-central area, but the two populations are now known to overlap, and where they do so, there is no consistent difference in size or in the species of pine attacked. Investigations were therefore made to determine whether the two populations would interbreed. Fertile offspring resulted when adults from lodgepole pine [*Pinus contorta*] in Idaho, which is within the area of distribution assigned to *D. monticolae*, were crossed with *D. ponderosae* from ponderosa pine [*P. ponderosa*] in Colorado, with 47 per cent. successful attacks on the test logs (including larval galleries) in the first generation and 53 per cent. in the second, and also when adults classed as *D. monticolae* from *P. contorta* were crossed with *D. ponderosae* from *P. ponderosa*, both from the area of overlapping distribution in northern Utah, with 59 and 12 per cent. successful attacks. Analysis of the length and width of examples of the various populations showed that the mean for the F_1 and F_2 generations was significantly different from and intermediate between that for the parents and that the variability in the F_1 and F_2 generations was similar to that of both parent populations. It is provisionally concluded that *D. monticolae* is a synonym of *D. ponderosae*.

DeBach (P.), Fisher (T. W.) & Landi (J.). **Some Effects of meteorological Factors on all Stages of *Aphytis lingnanensis*, a Parasite of the California Red Scale.**—*Ecology* **36** no. 4 pp. 743–753, 2 figs., 9 refs. Brooklyn, N.Y., 1955.

Aphytis lingnanensis Comp. [*R.A.E.*, A **44** 368] is an Aphelinid that has been established in southern California against *Aonidiella aurantii* (Mask.) on *Citrus* and has given very good control [*cf.* **45** 378], except in certain areas where the temperature is low in winter or occasionally at other seasons. Field and laboratory studies were therefore carried out on the effect of meteorological conditions on the parasite. In the field work, a small proportion of *Aphytis chrysomphali* (Merc.), which also parasitises *Aonidiella*, was present in the populations studied, and the results in general apply to both parasites. The following is based on the authors' summary of the work.

Field data based upon a pupal mortality index showed that *Aphytis* populations in southern California are more or less greatly reduced by low winter temperatures. The effect varies in different years and is less pronounced in coastal areas, in which the winter is mild, than in the interior valleys, in which it is colder. Almost complete pupal mortality was observed in interior areas. As a result, control of *Aonidiella* is commonest in coastal areas and rare in the interior. Subfreezing or average minimum temperatures are not necessarily the best index to mortality, since maximum temperatures (above

60°F.) have a favourable modifying effect, depending upon frequency and intensity. The pupal mortality index also showed a decided increase during the hot dry months of July, August, and September in the more severe climatic areas of the interior.

Laboratory studies at controlled temperature and humidity showed that all stages of *Aphytis* are adversely affected by low constant temperatures of 30–50°F. and in some cases by one of 60°F., depending upon the duration of exposure. The adult stage was the most susceptible, 100 per cent. mortality occurring after less than one day's exposure to 30°F. Cold-sterilisation of sperm in the males and in the spermathecae of the females also occurs at low temperatures. The pupal stage was the most resistant, but four days' exposure at 30°F. caused 66 per cent. mortality. The effects on the eggs and larvae were intermediate. Complete mortality of each of these stages was given by 2–4 days' exposure to 30°F., and high mortality by 4–8 days' exposure to 40 or 50°F. Even exposure for eight days at 60°F. caused some deaths. The eggs did not hatch at constant temperatures of up to 55°F., and there was little or no development beyond the young larval stage at 60°F. Exposure of eggs to low temperatures had a carry-over effect after removal to optimum conditions, the rate of development being reduced in relation to the intensity of the previous exposure to low temperatures. Equal but short alternating periods of high and low temperatures (80 and 40°F. for 12 hours) nearly eliminated the adverse effects that would have been shown by the low temperatures alone. The *Aphytis* adults were seriously affected by low atmospheric humidity, but the immature stages, because of their protected mode of life, were less affected. The life expectancy of the adults at 20 per cent. relative humidity was less than one-third as great as at 80 per cent. High temperatures combined with low humidities produced extreme effects, life expectancy at 90°F. and 20 per cent. relative humidity being only one-twentieth of that at 70°F. and 80 per cent. High temperatures (90°F.) greatly reduced the life expectancy of all stages, regardless of humidity.

These data indicate that the climatic zones in which an insect is the most abundant may not necessarily be those optimum for it. Biological control may reduce the population in the optimum zone, so that the host becomes scarce, but may be neutralised by climatic factors in a suboptimum zone, so that the host becomes relatively abundant. The net result will be a greater abundance of the host in a suboptimum climatic zone.

Ross (H. H.). **The Taxonomy and Evolution of the Sawfly Genus** *Neodiprion*.—*For. Sci.* **1** no. 3 pp. 196–209, 32 figs., 6 refs. Washington, D.C., 1955.

Hetrick (L. A.). **Life History Studies of Five Species of** *Neodiprion* **Sawflies.**—*Op. cit.* **2** no. 3 pp. 181–185, 7 refs. 1956.

The first of these papers contains a key to the species and subspecies of *Neodiprion* recognised by the author, followed by notes on some of them. With the exception of *N. sertifer* (Geoffr.), which is holarctic, and *N. insularis* (Cress.), known only from Cuba, all are exclusively North American. Seven species and three subspecies are described as new; these include *N. hetricki* and *N. taedae*, from *Pinus taeda* in Virginia, and *N. taedae* subsp. *linearis*, from the same pine in Louisiana and Arkansas and also recorded from Texas. *N. taedae taedae* has been misidentified as *N. americanus* (Leach) [*R.A.E.*, A **30** 181; **32** 98], which is a synonym of *N. abbottii* (Leach). *N. pratti* (Dyar), which was previously known only from the female type but of which the identity was established by the rearing of a large series of dark females

from *P. taeda* near the type locality in Virginia, is divided into three subspecies: *pratti*, of which *N. dyari* Rohw. [7 24] is a synonym, on *P. taeda* in Virginia, Maryland and Indiana, *banksianae* Rohw., on *P. banksiana* in Michigan, Wisconsin and Minnesota and in southern Canada from New Brunswick to Manitoba, and *paradoxicus*, n., on *P. banksiana* or *P. rigida* in Massachusetts and Connecticut.

In the second paper, an account is given of field and laboratory observations in Virginia on the bionomics of *N. exitans* Rohw. on *P. echinata* and of *N. abbottii*, *N. hetricki*, *N. pratti pratti* and *N. taedae taedae* on *P. taeda*.

Prebble (M. L.) & Graham (K.). **Studies of Attack by Ambrosia Beetles in Softwood Logs on Vancouver Island, British Columbia.**—*For. Sci.* **3** no. 1 pp. 90–112, 10 figs., 10 refs. Washington, D.C., 1957.

The following is based on the authors' summary. Five or more species of ambrosia beetles attack softwood logs in Vancouver Island. The species encountered in investigations in 1942–45 were *Platypus wilsoni* Swaine, *Trypodendron lineatum* (Ol.), *Gnathotrichus sulcatus* (Lec.), *G. retusus* (Lec.) and *Xyleborus* (*Xyleborinus*) *tsugae* (Swaine). Only *T. lineatum* and *G. sulcatus* were consistently present in the study material, and other species of *Trypodendron* may have been responsible for some of the damage observed. The investigations were undertaken to determine whether the intensity of the attack by the different species could be related to the time of felling of the logs and to the period of exposure. Sample blocks of 630 logs of Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*) and amabilis fir (*Abies amabilis*) comprising 96 lots representing different combinations of felling and examination dates were stripped of bark, the density of attack by each species was determined, and the block was sectioned radially to obtain a measure of damage. The progress of gallery construction was studied in detail in about one-third of the sample blocks.

The density of attack varied greatly with time of felling, period of exposure, timber species, beetle species, among different logs from the same tree, and to some extent within the same log. Serious study of intra- and inter-log variability was precluded by limitation of the sectioning technique to the ends of valuable 40- to 60-foot logs in commercial logging operations. Attack by *Trypodendron* and *Gnathotrichus* tended to be heavier in the shaded portions of the log. The number of holes appearing in radial sections was significantly correlated with the density of attack by *Trypodendron* and *Gnathotrichus* and the correlation was even more conspicuous when allowance was made for the extent of gallery development as well as the density of attack.

An appropriate measure of damage in infested logs should include the depth as well as the number of holes in radial sections. However, depth of holes is not determined by density of attack, nor is it a fixed characteristic of the beetles. The depth of penetration and the distribution of holes by depth classes appear to be influenced by characteristics of the logs attacked, including growth rate, moisture content, and (in the case of *P. menziesii*) the depth of sapwood. It is doubtful whether density of attack alone, or density of attack in combination with measurements of gallery development, will have practical value as indices of damage in log series with characteristics not necessarily conforming with those of logs in which detailed basic studies are made. If it is important to estimate damage in a given situation, direct enumeration of the number and depth of holes in radial sections of sample blocks can be made readily, without attention to density of attack and details of gallery development. In other circumstances, such as in the appraisal of influence of felling time or of insecticidal applications, it may suffice to have

an estimate of density of attack, by comparative counts of entrances per unit length or unit area of the logs, with the exclusion of depth of penetration and details of gallery development. However, in evaluating the effects of certain insecticides, it may be necessary to know whether gallery development has proceeded normally. Each of the species of ambrosia beetles has fairly distinctive and consistent patterns of attack in relation to season and felling date. Risk of damage is low in logs of *T. heterophylla* and *A. amabilis* felled in May or later, and in those of *P. menziesii* felled in June or later, provided that the logs are removed from the woods before the end of the following March.

Miller (L. A.). **Recovery of Insect Fragments from the Waste and Juice of processed Tomatoes.**—*Canad. Ent.* **88** (1956) no. 12 pp. 674–677, 4 refs. Ottawa, 1957.

Heliothis zea (Boddie) is rarely of economic importance on tomatos in southern Ontario, but heavy infestations, ranging up to 11 per cent., were found in ripe fruits in almost all the fields in two counties in 1953, so that the harvesting of fruit for processing had to be prematurely terminated. Infested fruits could not be readily separated from uninfested ones, since the only evidence of infestation when the larvae had entered immediately after hatching was a small scar almost impossible to detect. In 1954, therefore, the extent to which insect remains are removed during the commercial processing of the fruits was investigated. Examination of the waste and juice from batches of 50 uninfested tomatos to which almost full-fed larvae of *H. zea* had been added in numbers to simulate infestations of 2–100 per cent., and a batch of 250 tomatos containing 25 larvae, showed that the fragments visible without magnification, comprising head capsules and large pieces of cuticle, and most of the microscopic fragments, consisting mainly of pieces of cuticle, gut and trachea, occurred in the waste, but that many microscopic fragments passed with the juice through the perforations, 0·02 in. in diameter, of the sieve through which it was expressed. Infestation in southern Ontario rarely exceeds 2 per cent., and the juice from 50 tomatos infested to this extent contained only part of a leg and one seta. Slight contamination is therefore probably of frequent occurrence and unlikely to be detected by commercial sampling procedure. In addition to fragments of the added larvae, the juice was also found to contain Aphids, thrips, mites and eggs and fragments of adults of *Drosophila melanogaster* Mg. [*cf. R.A.E.*, A **45** 427, etc.]. Precautions to minimise contamination by *D. melanogaster* are reviewed.

Brown (N. R.) & Clark (R. C.). **Studies of Predators of the Balsam Woolly Aphid, *Adelges piceae* (Ratz.) (Homoptera: Adelgidae). II. An annotated List of the Predators associated with the Balsam Woolly Aphid in eastern Canada.**—*Canad. Ent.* **88** (1956) no. 12 pp. 678–683, 6 refs. Ottawa, 1957.

In this second paper of a series dealing with the predators of *Chermes* (*Adelges*) *piceae* Ratz. on balsam fir (*Abies balsamea*) in eastern Canada [*cf. R.A.E.*, A **46** 12], the authors review the native mites and insects that are suspected of preying upon it, give a list of some seven predacious insects introduced against it that were not recovered in the field, and record information on five introduced ones of which four are definitely and one doubtfully established. Of these last, *Laricobius erichsonii* Rosenh. [**42** 280], which was released each year from 1951 to 1955 and is well established in most of the liberation areas, is the most promising. *Scymnus* (*Pullus*)

impexus Muls. [**42** 250] was introduced each year from 1951 to 1955 and is established in most of the release areas, though it has increased and spread only slowly. *Cremifania nigrocellulata* Czerny [**45** 239] was introduced each year from 1952 to 1955 and is established in several areas, though spread is limited. *Leucopis* (*Neoleucopis*) *obscura* (Hal.) [**42** 263], which was introduced in 1933–36 and 1941, is well established over most of the range of *Chermes* in eastern Canada except Newfoundland, where a small liberation was made in 1954. *Aphidecta obliterata* (L.) [**42** 199] was not recovered following releases in 1941, 1951 and 1952, but progeny were obtained following a liberation in 1955.

Hedlin (A. F.). **Studies on the Balsam-fir Seed Chalcid,** *Megastigmus specularis* **Walley (Hymenoptera, Chalcididae).**—*Canad. Ent.* **88** (1956) no. 12 pp. 691–697, 6 figs., 6 refs. Ottawa, 1957.

Megastigmus specularis Walley, which was first recorded in eastern Canada in 1928 [*cf. R.A.E.*, A **20** 651], was reared from seeds of balsam fir (*Abies balsamea*) collected in a forest nursery in Saskatchewan in 1953 and was found to be abundant there and also in natural stands of *A. balsamea* in Manitoba in 1954. Loss of seed in 1954 and 1955 ranged from 22 to 57 per cent. In observations in Saskatchewan in 1955, adults emerged from infested seeds in outdoor cages between 1st and 29th June, beginning two days after the male cones of *A. balsamea* began shedding pollen. The ratio of males to females was 47 : 53. The adults fed readily on sugar solution in the insectary, and 13 males and 23 females lived for average periods of 9 and 13 days, respectively, when the average maximum and minimum daily temperatures were 68 and 48°F.; adults kept without food survived for about a week. Oviposition took place between 15th and 29th June in the field, and, during this period, males and females congregated round the cones and were not observed elsewhere. The egg, which, with the other immature stages, is described, is deposited within the seed embryo through the lowest exposed part of the cone scale, and 30 per cent. of 335 seeds examined contained more than one, though only one larva completed its development in each seed. Larvae were first observed in the field on 24th June, and the first four instars were completed within about five weeks. The fifth-instar larvae overwintered in the seeds on the ground from late July until May, but 65 per cent. of those that developed in 1954 remained in diapause for at least another year. In the cages, pupae were present from 14th May until 18th June, the pupal stage lasting 21–25 days for males and 20–26 days for females.

Herbert (H. J.). **Laboratory Studies on some Factors in the Life-history of the predacious Mite** *Typhlodromus tiliae* **Oudms. (Acarina: Phytoseiidae).**—*Canad. Ent.* **88** (1956) no. 12 pp. 701–704, 4 refs. Ottawa, 1957.

Mites are important predators of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) on apple in Nova Scotia, and the results are here given of laboratory studies of the effects of temperature and food on some aspects of the bionomics of *Typhlodromus tiliae* Oudm., which is the commonest of them. When kept at temperatures of 50, 60 and 70°F. in capsules, the eggs hatched in averages of 21·6, 7·59 and 4·76 days, respectively. The larvae fed little, if at all, but the nymphs, which were each provided with 20 or 40 eggs of *Tetranychus telarius* (L.) (*bimaculatus* Harvey) daily, fed voraciously. At 50°F., the larval stage lasted 2–3 days and the protonymphal stage five days, after which the nymphs died. At 60 and 70°F.,

the larval stage lasted one day, the protonymphal stage two days and one day, respectively, and the deutonymphal stage 9 and 5–6 days. Only fertilised females laid eggs, but mated and unmated mites survived for the same period and the females apparently pair and lay viable eggs at any time. Eggs were laid singly at intervals of 1–24 days. For females that each fed on 20 eggs of *T. telarius* a day, the duration in days of the preoviposition and oviposition periods, and the number of eggs laid per female were 8·25, 61 and 15·05 at 70°F. and 11·57, 76·84 and 15·32 at 60°F. When 40 eggs of *T. telarius* were provided per day, the corresponding figures were 5·9, 58·55 and 24·1 at 70°F. and 7·05, 80·3 and 22·65 at 60°F. Females lived for considerably longer than males; the survival period of both sexes was longer at the lower temperature, but was little affected by the number of eggs of *T. telarius* consumed. Nymphs fed on eggs of *P. ulmi* survived for only four days, and when adults that had been reared on eggs of *T. telarius* as nymphs and were subsequently provided with an unlimited supply of eggs of *P. ulmi*, the survival and oviposition periods and the number of eggs laid per female were all greatly reduced and the preoviposition period extended. Eggs of *P. ulmi* were difficult to transfer without injury to the capsules, whereas those of *T. telarius* were easily handled; in the field, *Typhlodromus tiliae* feeds readily on a diet of *P. ulmi*.

Thriving populations of *T. fallacis* (Garman) have been observed in the field associated with *Tetranychus* spp. and occasionally feeding on eggs of *P. ulmi*. When this species was reared in the laboratory on eggs of *T. telarius* at 70°F., the egg stage lasted 2·7 days, males and females survived for 12·1 and 40·5 days, the preoviposition and oviposition periods lasted 1·65 and 17·15 days, respectively, and the number of eggs laid per female was 44.

Bennett (F. D.). **Some Parasites and Predators of** *Pseudaulacaspis pentagona* **(Targ.) in Trinidad, B.W.I.**—*Canad. Ent.* **88** (1956) no. 12 pp. 704–705, 3 refs. Ottawa, 1957.

Pseudaulacaspis pentagona (Targ.) was formerly controlled on oleander (*Nerium oleander*) in Bermuda by a parasite that was introduced from Italy in 1921–24 and identified as *Aphytis diaspidis* (How.) [*cf. R.A.E.*, A **13** 136, 138, 456], but outbreaks have again occurred in recent years [**39** 150]. Studies were begun in Trinidad in March 1955 in an attempt to discover further parasites and predators that could be introduced to provide supplementary control. In Trinidad, *P. pentagona* occurs on a number of plants (including papaya (*Carica papaya*) and egg-plant (*Solanum melongena*)), but does not attack oleander and is rarely of more than minor importance, except on *Stachytarpheta cayennensis*, a pasture weed that is frequently defoliated by it towards the end of the dry season. The duration of the life-cycle remains constant throughout the year, whereas it is longer in the cool season in Bermuda, and there is apparently a slight increase in the population at the end of the dry season. Insect enemies are most abundant and possibly exert maximum control at this time, causing a drop in the Coccid population shortly afterwards.

Of the three parasites that attack *P. pentagona* in Trinidad, *Aspidiotiphagus citrinus* (Craw), which was by far the most abundant and *A. lounsburyi* (Berl. & Paoli), which was not common, already occur in Bermuda. The third is a species of *Aphytis* of the group of *A. proclia* (Wlk.), which was scarce, and from comparison with Compere's key [**44** 368] (in which specimens from Bermuda and Trinidad were not considered), both it and the one from Bermuda identified as *A. diaspidis* appeared to belong near *A. maculicornis* (Masi) or *A. bovelli* (Malen.). The genus *Aphytis* contains many races morphologically indistinguishable but separable biologically, and until

it is known whether the parasites from Trinidad and Bermuda are morphologically distinct, it is proposed to refer to them as *Aphytis* sp. *proclia* group (Trinidad strain) and *Aphytis* sp. *proclia* group (Bermuda strain), respectively.

At least eight predators were associated with *P. pentagona* in Trinidad, of which the commonest, in order of decreasing abundance, were *Cybocephalus* sp., *Cryptognatha simillima* Sic., *Pentilia insidiosa* Muls., *Coccidophilus citricola* Brèth. and *Chilocorus cacti* (L.). The last is already established in Bermuda as a result of introduction from Jamaica in 1951, and *Cybocephalus* sp. also became established there following introductions from Trinidad in 1948 and 1951, when *Cryptognatha simillima*, *P. insidiosa* and another predator, *C. nodiceps* Mshl., were also liberated but failed to become established. Further releases of predators from Trinidad were made in 1955, but only the two already present were recovered.

Reid (R. W.). **The Bark Beetle Complex associated with Lodgepole Pine Slash in Alberta. Part II. Notes on the Biologies of several Hymenopterous Parasites.**—*Canad. Ent.* **89** no. 1 pp. 5–8, 2 figs., 4 refs. Ottawa, 1957.

In this second part of a series [*cf. R.A.E.*, A **45** 177], records are given from the literature on the hosts and distribution of a Braconid and three Pteromalids associated with broods of *Ips pini* (Say) and *I. perroti* Swaine in the slash of lodgepole pine [*Pinus contorta* var. *latifolia*] in Alberta, followed by notes on their bionomics. The bionomics of the Braconid, *Coeloides dendroctoni* Cushm., resembled those described for it elsewhere [**24** 184]. Of the Pteromalids, *Pachyceras xylophagorum* Ratz. was active from late June till early August, and one female was observed to enter a gallery of *Ips* to oviposit. Reared adults emerged from the wood from early August till September, and though most appeared to have overwintered in the adult stage, some may have done so as larvae or pupae. Adults of *Rhopalicus pulchripennis* (Crwf.) were present on the slash at about the same time as those of *Pachyceras*, and the females oviposited through the bark. Reared adults emerged in early August. A female of *Tomicobia tibialis* Ashm. was observed attempting to oviposit in an adult *Ips* in spring, and pupae were found in autumn in many dead adults of *I. pini* and *I. perroti*. Winter was passed in the pupal stage, and the adults emerged in spring.

Barter (G. W.). **Studies of the Bronze Birch Borer, *Agrilus anxius* Gory, in New Brunswick.**—*Canad. Ent.* **89** no. 1 pp. 12–36, 12 figs., 33 refs. Ottawa, 1957.

The bionomics of *Agrilus anxius* Gory, all stages of which are described, the damage that it causes and its natural and artificial control were studied on yellow birch and white birch (*Betula lutea* and *B. papyrifera*) in New Brunswick during 1941–50, following the discovery of the close association of this Buprestid with die-back [*cf. R.A.E.*, A **29** 347; **32** 327]. A detailed account is given of the findings, and the following is based partly on the author's summary of them.

The life-cycle of *A. anxius* usually lasts two years, but when the cambium of the tree is weakened by repeated or heavy attacks or, occasionally, when the eggs are laid early in the season, it is sometimes completed in one. Winter is spent in the larval stage, and larvae in all five instars are then present, but experiments indicated that only those that have reached the last instar before the onset of winter and are subsequenly exposed to temperatures below freezing-point give rise to adults. Adult emergence begins about 25th June and continues for about six weeks, reaching a peak

in mid-July. Adults are present until about the end of August. Oviposition occurs only during rain-free weather with temperatures of 70°F. and above. The eggs are deposited, singly or in groups of up to 16, under loose bark or in cracks. Most are laid on the sunny side of the tree, indicating a phototropic response by the female, but an olfactory response determines the choice of the tree and the oviposition site on it. The larva makes its gallery between the bark and the wood, girdling the branch or stem, and usually enters the wood at different times during development, for moulting, to escape from unsuitable feeding conditions in the cambium, or to overwinter. The leaves on infested trees become chlorotic and reduced in size and number, the number of shoots on the upper stem and in the lower crown is increased, the annual radial growth is reduced, and death of the branch or tree results if attack is heavy.

Egg parasites were the most important natural enemies. An undescribed species of *Thysanus* and an Encyrtid identified as *Coccidencyrtus* sp. together parasitised an average of 55 per cent. of the eggs, and a further 5 per cent. failed to hatch. The larvae were parasitised by five Hymenoptera, of which *Atanycolus charus* (Ril.) and *Phasgonophora sulcata* Westw. were the most important, but the average percentage parasitism was only 9; woodpeckers removed up to 51 per cent. of the older overwintering larvae and prepupae in spring. In outbreak periods, mortality among larvae from eggs laid in healthy trees is the major regulating factor. Since *Agrilus* can only multiply and reach outbreak proportions in weakened trees, measures that tend to promote tree vigour appear to provide the most satisfactory means of control [*cf.* **32** 110, 146]. In laboratory experiments, adults died 24–48 hours after exposure for 30 minutes to surfaces sprayed with 1 or 2 lb. wettable DDT per 100 gals. In a field test, two thorough applications of a spray of 10 lb. DDT per 100 gals., with an adhesive, gave complete protection in a stand of young trees, and two of 5 lb. DDT per 100 gals. in wettable-powder or emulsion spray greatly reduced attack. The first application was made about a week before the adults emerged and the second 2–3 weeks later. Chemical control is unlikely to be justified in forest stands, but would be on shade trees if accompanied by measures to increase tree vigour.

Zuk (P.). **Note on Damage to Lead Cable by the Brown House Moth, *Hofmannophila pseudospretella* (Staint.) (Lepidoptera: Oecophoridae).** —*Proc. ent. Soc. B. C.* **53** pp. 12–13, 1 fig. Vernon, B.C., 1957.

In August 1955, the lead sheathing of telephone cables at a race track in Vancouver was found to be pitted and perforated with small holes. The cables were enclosed in a wooden casing, and the damage occurred close to areas in it where rat bait, consisting of maize meal, oats and warfarin, had been allowed to accumulate for 18 months. Adults of *Hofmannophila pseudospretella* (Stnt.) were observed inside the casing, and the bait was found to contain larvae, webbing, frass and pupal cases of this moth. Microscopic examination revealed particles of lead among the webbing of pupal cases and in pellets of frass round them, indicating that the damage had been caused by late-instar larvae. *H. pseudospretella* is a pest of stored foodstuffs in British Columbia, having been taken in cereal warehouses in cities on Vancouver Island and in the Okanagan Valley.

King (K. M.), Forbes (A. R.) & Noble (M. D.). **Chemical Control of Root Maggots in early Cabbage.**—*Proc. ent. Soc. B. C.* **53** pp. 28–34, 16 refs. Vernon, B.C., 1957.

At Victoria, British Columbia, early cabbages are transplanted in April or May, and since adults of *Hylemyia brassicae* (Bch.) begin to emerge from the

overwintered puparia during the first prolonged warm period in these months and oviposit about a week later, the peak of spring egg-laying occurs before the plants are fully established. It is essential to prevent attack for at least ten days after transplanting and to minimise it for a further 3–4 weeks. The plants may also receive considerable numbers of second-generation eggs when nearly mature, but this does not greatly affect production.

Large-scale experiments on protection by means of chemicals were carried out in 1947–53 and 1955. Dusts were applied at 40 lb. per acre and sprays at 3 oz. per plant, both to the soil round the base of the plant. Ten insecticides were tested, and aldrin and heptachlor proved the most effective and economical; one application of 2·5 per cent. dust soon after the plants were set out gave almost complete control, and emulsion sprays containing 1 lb. toxicant per 100 gals. gave comparable results and also killed wireworms. Dipping the root and stem of the plant in an emulsion containing 0·2 oz. aldrin or heptachlor per gal. gave almost complete protection, but caused some plant damage. Dieldrin, in dust and spray, was about as effective as these two materials in the one year in which it was tested. Chlordane in dusts and sprays gave promising results in some early tests, but the dust proved unreliable in later ones, particularly when infestation was heavy. BHC in dust (0·5 per cent. γ isomer) and spray (0·25 lb. γ isomer per 100 gals.) gave outstanding protection when applied 2–3 times, and single applications gave poorer but commercially adequate results. Two applications of 2 per cent. parathion dust gave good protection in 1948, but this material was not tested further because of its high mammalian toxicity. When the transplants were moistened and the stems dusted with 1 oz. 50 per cent. DDT powder per 250 plants, good control was obtained in 1948 and 1950, but not in 1949, and dipping the whole plants in 1 oz. 50 per cent. wettable DDT per gal. was effective in 1950–52. Drenching with corrosive sublimate [mercuric chloride] (1:1,600) and dusting with 4 per cent. calomel [mercurous chloride] in talc three times at intervals of 10 days, beginning just after transplanting, gave reasonable control, but these two treatments were less effective than others and resulted in low yields, presumably owing to phytotoxicity. Dusting with toxaphene, spraying with DDT or treating the stems with calomel gave unsatisfactory protection.

Brookes (R. F.), Cranham (J. E.), Greenwood (D.) & Stevenson (H. A.). **The Toxicity of organic Sulphides to the Eggs and Larvae of the Glasshouse Red Spider Mite. II. Miscellaneous Sulphides.**—*J. Sci. Fd Agric.* **8** no. 10 pp. 561–565, 29 refs. London, 1957.

Clark (N. G.), Cranham (J. E.), Greenwood (D.), Marshall (J. R.) & Stevenson (H. A.). **III. Benzyl Phenyl Sulphides substituted only by Halogens.**—*T. c.* pp. 566–570, 7 refs.

Bisphenylthiomethane and 1,2-bisphenylthioethane, two of a series of S,S′-disubstituted alkane-$\alpha\omega$-dithiols tested against the eggs and young stages of *Tetranychus telarius* (L.) [*cf. R.A.E.*, A **45** 421], were found to be phytotoxic when applied in the field, but were sufficiently effective against the mite to justify the synthesis of similar compounds, in the hope of discovering some that would be both effective and safe. Compounds consisting of two benzene nuclei linked by a bridge containing sulphur were synthesised by methods indicated and tested in the laboratory by the same methods as before [*cf. loc. cit.*], and the results obtained with a large number of compounds of various types tested as dips are given and discussed in the first of these two papers.

The most effective were the dibenzyl disulphides and the benzyl thiolobenzoates; in other groups, only 1,2-dichloro-1,2-bisphenylthioethylene showed comparable toxicity. The dibenzyl disulphides were more effective than the corresponding diphenyl disulphides or the dibenzyl monosulphides, and the benzyl thiolobenzoates generally more so than the isomeric aryl phenylthioloacetates and the corresponding phenyl thiolobenzoates; the N-benzyl-N-methylbenzenesulphenamides and the aryl thiolobenzoates, with the exception of p-chlorophenyl thiolobenzoate, showed little toxicity, and the aryl phenacyl sulphides were the least active.

There was no consistent relation between compounds substituted by chlorine in the para position and unsubstituted compounds. Dibenzyl disulphide, 1,2-dichloro-1,2-bisphenylthioethylene and 1,2-bisbenzylthioethylene were more toxic and phenyl phenylthioloacetate and phenyl 2-phenylethyl sulphide less toxic than the corresponding bis-p-chloro compounds, whereas the substituted and unsubstituted benzyl thiolobenzoates and dibenzyl sulphides had the same order of activity. Similar variation was found between bis-p-chlorination and mono-p-chlorination; the bis-p-chlorinated derivative was the most active of the phenyl phenylthioloacetates, the bis-p-chlorinated derivative of phenyl thiolobenzoate was probably less active than either of the mono-p-chlorinated compounds, and the bis- and mono-p-chlorinated derivatives of benzyl thiolobenzoate had a very similar order of activity. Although para-chlorination did not cause a consistent increase in ovicidal effect, as had been observed with other series of compounds [*cf.* **38** 377; **39** 49], it often had a marked effect in yielding more active compounds.

In further tests with some of the more promising compounds, dibenzyl disulphide caused 100, 92–94, 87 and 79 per cent. mortality of eggs and young mites when used at concentrations of 0·05, 0·025, 0·0125 and 0·00625 per cent., respectively, and bis-p-chlorobenzyl disulphide 100, 52–71, 36 and 7 per cent.; the corresponding percentages were 97, 71, 48 and 17 for benzyl thiolobenzoate, 99, 79, 72 and 60 for benzyl p-chlorothiolobenzoate, 100, 100, 76 and 48 for benzyl p-nitrothiolobenzoate and 84–92, 76–82, 48–53 and 28–37 for 1,2-dichloro-1,2-bisphenylthioethylene. Other very effective compounds were bis-p-fluorobenzyl disulphide, which gave 99 and 72 per cent. mortality at the first two concentrations, and bis-2-phenylethyl disulphide and p-chlorobenzyl thiolobenzoate, which gave 95, 85 and 59, and 100, 94 and 78 per cent., respectively, at the first three; p-chlorobenzyl p-chlorothiolobenzoate gave 91 per cent. kill at the first concentration, but only 57 per cent. at the second.

The second paper contains the results of further experiments, carried out as a consequence of the observations that, although the toxicity of benzyl phenyl sulphide was low, the substitution of halogens on either or both of the benzene nuclei considerably increased it and resulted in compounds of little or no phytotoxicity. The compounds were tested in dips, as before, and the most promising ones also in sprays at 0·02 and 0·01 per cent. [*cf.* **45** 421]. As there was evidence of the oxidation of such sulphides after application to leaf surfaces [*cf.* **42** 67], many were oxidised to the corresponding sulphoxides and sulphones, which were also tested.

In the mono-substituted compounds, there was a marked difference in activity, depending on which of the two nuclei was affected. Substitution in the para position on the phenyl ring gave compounds much less active than corresponding compounds substituted on the benzyl ring. There appeared to be a general increase in effectiveness of substituted phenyl compounds from fluorine through chlorine and bromine to iodine. All other compounds in which a halogen was substituted in the para position on both nuclei or on the benzyl ring only were very effective, with the exceptions of p-fluorobenzyl p-fluorophenyl sulphide and p-iodobenzyl p-iodophenyl sulphide. These exceptions were the more remarkable as p-chlorobenzyl

p-chlorophenyl sulphide (chlorbenside), the corresponding bromo-compound and all other combinations of fluorine or of iodine with other halogens were very effective.

Substitution in the meta position on the benzyl ring, when the phenyl ring was substituted with fluorine or chlorine in the para position, gave compounds less active than the corresponding para-substituted benzyl derivatives; the ortho-substituted benzyl derivatives were the least active. Substitution by more than one halogen atom on either nucleus resulted in compounds of lower activity than the corresponding compounds substituted only in the para positions. The 2,6-dichlorobenzyl compounds were notably inactive.

In contrast to the high activity of most of the bis-p-halogen-substituted benzyl phenyl sulphides, the activity of the corresponding sulphoxides and sulphones was low or negligible, except for those derived from p-chlorobenzyl p-chlorophenyl sulphide (chlorbenside) and p-chlorobenzyl p-fluorophenyl sulphide [*cf.* **42** 67]. In other derivatives, there was generally low activity in the sulphoxides but not in the sulphones. Such activity as there was appeared to depend on the lipoid solubility of the compounds, as gauged by their solubility in benzene, and occurred usually in compounds with fluorine or chlorine in the para position on the phenyl nucleus and not in those with bromine or iodine in that position.

Duerden (J. C.) & Cutler (J. R.). **The Storage of Groundnuts under tropical Conditions. I. The Effects of prolonged Storage on undecorticated and decorticated Groundnuts.**—*J. Sci. Fd Agric.* **8** no. 10 pp. 600–604, 4 refs. London, 1957.

As groundnuts grown in northern Nigeria have to be stored at the railheads for up to a year or more and the customary method of shelling, by means of a pestle and mortar, results in many broken nuts, the resulting losses due to insects and other causes are sometimes great. In investigations at Kano, groundnuts harvested at the end of 1953 were shelled in the usual way or by hand, which much reduced the proportion of broken nuts, or left unshelled, and were then fumigated with methyl bromide, sieved to remove dust, bagged, and stacked in a warehouse in May 1954, just before the onset of the rains. To ensure adequate infestation, batches of about 500 adults of *Tribolium castaneum* Hbst. were liberated at intervals in the warehouse. The groundnuts were examined after 10–16 months, and *T. castaneum*, *T. confusum* Duv., *Oryzaephilus mercator* (Fauv.) and *Xylocoris flavipes* Reut. were recovered from them. No large differences in direct losses of nuts, as weight lost or as powder produced, in weight per bushel or in oil content were found between the different categories of nuts, but the production of free fatty acids was much greater in the first and less in the last than in the hand-shelled samples [*cf. R.A.E.*, A **40** 200–201]. Insect damage increased very slowly in the unshelled groundnuts and was observed only in pods with incomplete shells [*cf.* **46** 150]. In shelled groundnuts, insects attacked broken nuts rather than whole ones, and it is concluded that the quality of the commodity after storage is considerably lowered by shelling, especially if this results in a high proportion of broken nuts.

Forsyth (J.). **Insect Infestation in stored Cocoa in Ghana.**—*Ghana Fmr* **1** no. 4 pp. 133–135, 1 fig. Accra, 1957.

The principal insect pests of stored cacao in Ghana are *Lasioderma serricorne* (F.), severe infestation by which occurred at Takoradi in 1954, *Ephestia cautella* (Wlk.) and *Araecerus fasciculatus* (Deg.). Notes are given on the

bionomics of the last two, largely from the literature [*cf. R.A.E.*, A **22** 618]. Other species also occur, and two shipments were rejected on arrival in the United States in 1955 because of the presence of insects. The only insecticide permitted for use on stored cacao is pyrethrum. This is being used with piperonyl butoxide in a proprietary preparation and applied as an aerosol by means of a mechanical fog generator in storage premises. It kills all insects in flight or on the stacked bags at the time of treatment, but fumigation of the stacks with methyl bromide, which is common practice in other countries, would be necessary to kill those in the beans.

Cachan (P.). **Les Scolytoidea mycétophages des forêts de Basse Côte-d'Ivoire.**—*Rev. Path. vég.* **36** fasc. 1–2 pp. 1–126, 5 pls., 35 figs., 3 pp. refs. Paris, 1957.

This paper is divided into two parts. In the first, the author reviews the nature of the problem presented by ambrosia beetles (Platypodids and Scolytids) and gives lists of those present in the forests of the lower Ivory Coast (with notes on their importance) and the results of experiments on the susceptibility of some 30 indigenous timbers to attack. Some species of economic importance were susceptible, but others were not infested; the trees attacked by 25 species of beetles are shown. Ambrosia beetles are of little importance as regards standing trees, but the galleries excavated in freshly felled timber reduce its value. In addition, the galleries afford entry to harmful fungi. The second part comprises a detailed account of investigations on the bionomics and ecology of *Platyscapulus auricomus* (Schauf.), selected as typical of the group. They included tests on the substances that attract this Platypodid to its host-trees, and an apparatus in which paper chromatograms of various extracts were offered to the insects was found useful for this purpose, the beetles congregating on the spots corresponding to the attractive materials.

Swirski (E.). **Experiments in controlling Citrus Rust Mite** (*Phyllocoptruta oleivora* **Ashm.**).—*Ktavim* (Engl. edn.) **6** pp. 91–99, 2 graphs, 3 refs. Rehovot, 1956.

As *Citrus* grown in Israel requires treatment in late spring and summer to correct zinc deficiency and control attack by *Phyllocoptruta oleivora* (Ashm.) and *Chrysomphalus ficus* Ashm. (*aonidum*, auct.), tests were made in 1955 to discover whether the sulphur used against the mite could be applied with the zinc compound, and whether it could be replaced by an acaricide that could be applied with, or within a short time of, the oil spray necessary against the scale. The addition of sulphur to a zinc-sulphate spray or zinc-oxide dust did not reduce control of *P. oleivora* on leaves or fruit; the spray was more effective than the dust, but dusting is preferred because both the material and the machinery are relatively cheap. When applied in sprays with a wheelbarrow hand-sprayer on 20th June, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] had a somewhat longer residual effect than chlorobenzilate [ethyl 4,4′-dichlorobenzilate] and was more effective against the mite than Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] or parathion, but less effective than the sulphur sprays and dusts. When applied with a power sprayer on 2nd August, sprays of diazinon in oil emulsion gave effective mite control for 22–25 days, whereas similar sprays incorporating malathion or parathion and oil emulsions alone were ineffective.

Rivnay (E.). **Studies on the Control of the Fruit Fly in Valencia Orange Groves in Israel.**—*Ktavim* (Engl. edn.) **6** pp. 101–109, 4 refs. Rehovot, 1956.

In Israel, Valencia oranges are attacked by the Mediterranean fruit-fly [*Ceratitis capitata* (Wied.)] in spring, when the population of the Trypetid and its activity are increasing, and when insecticides may be washed off the trees by rain soon after application or injure bees or predacious insects. Other *Citrus* fruits are attacked in autumn, when the fruit-fly population is decreasing. Observations and experiments in 1951–55 showed that groves of Valencia oranges remain free from *C. capitata* until April or May, especially if neighbouring Jaffa oranges have been sprayed in autumn [*cf. R.A.E.*, A **45** 139], but treatment is necessary for later protection. Sprays of dieldrin applied before flowering, in February or early March, failed to protect the fruits from the heavy spring invasion, and the sprays must therefore be applied later in March, even though the trees are in blossom and bees may be injured. If cold weather continues until late April, a single application will safeguard the fruits until May, but a second may become necessary if picking is postponed. As the timing of applications depends on weather, trapping or careful observations of adult activity are required. Dieldrin, methoxy-DDT (methoxychlor) and DDT are the insecticides suggested, but bees should not be brought into the grove until at least four days after treatment with methoxy-DDT or seven days after treatment with dieldrin or DDT. Coccids on *Citrus* are partly controlled by natural enemies, particularly *Chilocorus bipustulatus* (L.), which may be killed by sprays applied against the fruit-fly. The results of two tests indicated that dieldrin causes less mortality of *Chilocorus* than DDT or methoxy-DDT, particularly after weathering for 3–4 days, but further investigations on the effect on other beneficial insects are necessary.

Varma (P. M.). **Ability of the White-fly to carry more than one Virus simultaneously.**—*Curr. Sci.* **24** pp. 317–318, 2 figs., 14 refs. Bangalore, 1955.

The viruses transmitted by *Bemisia tabaci* (Gennadius) in India include yellow vein mosaic of bhendi [*Hibiscus esculentus*] [*R.A.E.*, A **45** 35] and a previously unreported yellow vein mosaic of pumpkin, of which the symptoms are described and which also infects other cucurbits, but not *H. esculentus* or other malvaceous plants. When examples reared on cotton were allowed to feed for 24 hours on infected *H. esculentus* before or after feeding for 24 hours on diseased pumpkin and were then transferred to healthy *H. esculentus* and pumpkin in succession for nine days and allowed to feed for 24 hours on each plant, each virus was transmitted to its respective host-plant, and the same result was obtained when the feeding periods on them were halved. *B. tabaci* can thus harbour two viruses simultaneously, transmit them on the same day, and preserve them for several days without recourse to a fresh source of infection. Such behaviour was previously known for Cicadellids [*cf.* **25** 490] but not for Aleyrodids.

Nishio (Y.). **A new Species of *Tenuipalpus* of the Family Phytoptipalpidae (Acarina).** [*In Japanese.*]—*Ōyō Kontyū* **12** no. 2 pp. 80–81, 1 fig., 2 refs. Tokyo, 1956. (With a Summary in English.)

The new species described (in Japanese and English) is named *Tenuipalpus japonicus*, and it was found on persimmon (*Diospyros kaki*) in Japan in 1955.

Hiura (I.). **Description of a new Species of Japanese Anthocoridae, and its Biology (Hemiptera-Heteroptera).** [*In Japanese.*]—*Sci. Bull. Fac. Agric. Kyushu* **16** no. 1 pp. 31–40, 4 pls., 46 refs. Fukuoka, 1957. (With a Summary in English.)

A description is given in English of the adults of both sexes of *Euspudaeus beneficus*, sp. n., which occurs in piles of rice stems in the field in various parts of Japan. This Anthocorid preys on many species of small insects in the heaps, including, in the Saga district, *Chilo suppressalis* (Wlk.). It has at least two generations between May and August. The eggs are laid in the tissues of the stems and hatch in about a week, and the nymphal stage lasts about a month. For the maintenance of a large population, the stems must be preserved throughout the year and not allowed to become too dry.

Wyatt (I. J.). **Field Investigations of Padi Stem-borers, 1955–1956.**—*Bull. Dep. Agric. Malaya* no. 102, [4+] 42 pp., 12 figs., 5 refs. Kuala Lumpur, 1957.

Investigations on the Lepidopterous stem-borers that attack rice in Malaya [*cf. R.A.E.*, A **46** 153] were continued in the field in 1955–56. The area selected was about 53 sq. miles in extent, in the North Krian district of Perak, and bounded on the west by the sea. The vegetation in May–June, between rice seasons, consisted chiefly of sedges and grasses, and self-sown rice, which was widely distributed, comprised about 2 per cent. of it. The tillers of this rice showed 20–70 per cent. infestation by borers, but the sedges were only lightly attacked, mainly just after the rice harvest, and the wild grasses hardly at all. Crop infestation thus originated chiefly from the self-sown rice. A mid-season survey, carried out in October when the crop was about 30 ins. high, showed that an average of only about 2 per cent. of the tillers was infested, but infestation had increased to an average of 44 per cent. by January, just before harvest. Examination of sub-samples showed that the increase began in October. Of the larvae found, 341 were *Chilotraea polychrysa* (Meyr.), 73 *Schoenobius incertulas* (Wlk.), 17 *Sesamia inferens* (Wlk.) and only two *Chilo suppressalis* (Wlk.). Attack was most severe in the more fertile sections, and particularly in dense stands of rice or in the shelter of banks or trees, presumably because the ovipositing adults preferred positions sheltered from the wind. Catches of adults in a simple light-trap, which is described, indicated that *Chilotraea* and *Schoenobius* were rare until September, numerous from October to February and scarce in March and April. About twice as many females as males were taken, the ratio falling from about 3:1 in October to 1·4:1 in March. Extremely small numbers of *Chilo* and *Sesamia* were caught, all in December–March. These results are discussed and compared with those recorded by Pagden [**21** 573].

Replicated field experiments in which an emulsion spray of 1 lb. DDT per acre was applied on various dates confirmed that the plants were most vulnerable to attack just before flowering [*cf.* **46** 153] and that although infested plants produced extra tillers, these did not appreciably reduce loss of yield [*cf.* **46** 154]. The last point was confirmed in a test in which the plants were artificially damaged to simulate borer injury. In three sections with different levels of soil fertility, spraying was most effective between early November and early December, four weeks before flowering. The borers were estimated to have caused 26–70 per cent. loss of yield on the experimental sites and to have destroyed probably a third of the yield over the whole area. Spraying with dieldrin was also effective in a subsidiary test.

An experiment on the control of borers in rice nurseries gave inconclusive

results, owing to negligible infestation, but, as reported in an appendix, 0·8 lb. dieldrin per acre in an emulsion spray was effective against *Nymphula depunctalis* (Gn.) on the young rice three weeks after spraying. In the main experiment, two fortnightly applications of 1 lb. DDT per acre gave almost complete control of a mild outbreak of *Cnaphalocrocis medinalis* (Gn.) for at least two weeks. In another appendix, it is reported that the DDT spray was not found to injure fish in the water of the rice-fields, whereas dieldrin at the same rate was toxic to them [*cf.* **46** 154]. In laboratory tests, DDT and γ BHC were much less toxic to fish than dieldrin and endrin, and wettable powders were less injurious than emulsion concentrates.

Wallace (M. M. H.). **Experiments on the Treatment of Pastures with DDT and BHC for the Control of the Red-legged Earth Mite,** *Halotydeus destructor* **(Acarina: Penthaleidae), with an Appendix on Tests with other Insecticides.**—*Tech. Pap. Div. Ent. Commonw. sci. ind. Res. Org. Aust.* no. 1, 37 pp., 3 pls., 2 graphs, 15 refs. Melbourne, 1957.

Dusts of DDT or BHC in superphosphate have given satisfactory control of *Halotydeus destructor* (Tucker) in pastures of subterranean clover [*Trifolium subterraneum*] in various parts of Australia [*cf. R.A.E.*, A **35** 158] and their value for use over large areas of annual pasture including this clover in Western Australia was accordingly investigated in comparative tests in 1946–52. The following is based almost entirely on the author's summary of the results. In a preliminary experiment, mixtures of DDT or BHC with superphosphate applied by hand sifter to small ungrazed plots gave excellent control. Late summer applications at rates as low as 4 oz. p,p′DDT per acre gave good control of mites hatching with the subsequent autumn rains, but higher concentrations were required in order to maintain control until the end of the season. A rate of 1 lb. p,p′DDT per acre continued to restrict mite-numbers for two seasons after treatment, and treatment at 4 lb. per acre repressed the mite population to a negligible level for up to three seasons. Winter treatment at rates as low as 1·6 oz. p,p′DDT per acre gave good initial control, but higher rates were required to maintain it for more than one season. An application of 4 lb. p,p′DDT per acre shortly after the hatching of the aestivating eggs maintained control into the fourth season. Late summer or early autumn application of BHC (13 per cent. γ isomer) at the relatively high rate of 4 lb. per acre in superphosphate was effective in controlling mites hatching in autumn, but only when applied not more than a month before their appearance. Winter treatment at the more economical rate of 8 oz. per acre gave good initial control, but the persistent effect was limited.

The large-scale distribution of DDT in superphosphate by broadcaster or drill, the farm implements usually employed for the distribution of superphosphate, was less effective than hand treatment. Late summer applications of 1 lb. p,p′DDT per acre gave satisfactory kill when the mites hatched in the autumn, but the persistent effect was poor. An application at 2 lb. per acre by means of the drill, which was more effective than the broadcaster, gave very good results, with control persisting into the second season. Applications of DDT in inert dust diluents by means of power equipment were equal in effect to the drill applications of DDT in superphosphate. Winter treatments by broadcaster at a rate of 8 oz. p,p′DDT per acre gave good initial kill, but the persistent effect was limited. Sprays were inferior to the dusts when applied by low-volume boom sprayer at rates of 0·5 or 1 lb. p,p′DDT per acre in summer, but gave very good results when applied at the lower rate in winter from the air.

Special experiments indicated that the main factors operating against more effective control in the large-scale field tests were loss of DDT in wind drift, unevenness of distribution, and the burial of DDT in the soil by the trampling of stock. Treatment with DDT is economically justifiable in pastures of subterranean clover that have not yet become established, but it is not known whether it would be so in established pastures. A serious limitation is the observed increase in populations of *Sminthurus viridis* (L.) following its use [*cf.* **43** 78]; where small populations of *S. viridis* are present with the mite, parathion should be added to the DDT [**43** 411], or BHC substituted for it.

Comic (F.). **Contribution à l'étude des cochenilles d'intérêt économique de Nouvelle-Calédonie et dépendances.**—[*Tech. Pap. S. Pacif. Comm.*] no. 116, iii + 36 + 3 pp., 5 refs., multigraph. Nouméa, 1958.

A list is given of Coccids recorded in New Caledonia and its dependencies, showing their food-plants, distribution and, usually, economic importance, together with another, in which they are shown under the plants that they attack. In the introduction, which is published in both English and French, it is pointed out that all the species that constitute a threat to cultivated plants are introduced, and that several of them have become widely distributed. The importance of establishing adequate phytosanitary measures to prevent further introductions is emphasised.

Halffter (G.). **Plagas que afectan a las distintas especies de *Agave* cultivadas en México.** [Pests affecting the various Species of *Agave* cultivated in Mexico.]—135 pp., 5 col. pls., 30 figs., 33 pp. refs. México, D.F., Direcc. gen. Def. agríc., Sec. Agric. Ganad., 1957.

Species of *Agave* are extensively grown in the arid regions of Mexico for the production of drinks (mescal and pulque) and fibre. The species concerned and their cultivation are reviewed, and information is given on the pests and diseases that attack them.

Mescal is produced chiefly in the Tequila region, and the main species there is *A. tequilana*. Its principal pest is the Hesperiid, *Aegiale* (*Acentrocneme*) *hesperiaris* Wlk. [*cf. R.A.E.*, A **13** 23], which occurs in great numbers and causes a reduction in plant growth and sugar content. The adults emerge in August–September or later, and the eggs are laid at dusk in October–November on the lower surfaces of the terminal third of the leaves, singly or in groups ranging up to 14, though they usually number 3–6. The larvae hatch in 28–40 days, though they have been stated to do so in 15–20 days in optimum conditions, in December–January, and mine in the leaves towards the base, sometimes leaving the mines and beginning new ones, which become wider as the larvae develop. They feed voraciously, and a gummy substance is extruded from their galleries. They become full-fed between the end of August and early October, and attack the bulb-like bases of the plants just before pupating. The pupal stage is passed in the bases and lasts 30–90 days. The larvae are attacked by an entomogenous fungus and a Braconid; a Tachinid of the genus *Arthrochaeta* emerges from the pupae. Together, these agents afford considerable control, and care should be taken not to reduce their effectiveness by the indiscriminate use of insecticides. Infestation can be reduced by the use of uninfested planting material and its effects mitigated by weed control, to increase insolation, and hormone treatment, to encourage growth. In tests of insecticides, lindane

[γ BHC] and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] proved effective against larvae exposed to filter paper treated with emulsified solutions, the first giving the best results, but neither of the liquids had any effect on larvae in their galleries; treatment at the time of oviposition against the adults and newly hatched larvae might be of value. The plants are also attacked by a few other insects and rodents, but the former are of little importance.

The main species grown for fibre, chiefly in Yucatan, are *Agave sisalana* and *A. fourcroides*. *A. sisalana* is less common and is attacked by *Prodenia ornithogalli* Gn., a Tettigoniid of the genus *Liparoscelis*, and the larvae of *Batrachedra* spp. All can be controlled with DDT or BHC in sprays or dusts. *A. fourcroides* is widely grown. Its principal insect pests are the Cicadellid, *Homalodisca triquetra* (F.), and the weevil, *Scyphophorus interstitialis* Gylh. (*acupunctatus* Gylh.) [*cf.* **33** 131]. *Homalodisca* weakens the plants by sucking the sap, and its feeding sites afford entry for bacteria and fungi, which cause more serious damage. *Scyphophorus* feeds on all parts of the plant, though it is commonest in the central leaves, and severe infestation destroys the fibres and often the whole plant. DDT does not give good control, but BHC sprays are effective and also control *Homalodisca*. Some damage is caused by the Dynastid, *Strategus julianus* (Burm.), which can be controlled by watering the plants with chlordane in emulsion form.

Janvier (H.). **Comportement de *Tiphia morio* F. dans la destruction des *Amphimallon majalis* Raz. (Hym. Tiphiidae).**—*Ann. Soc. ent. Fr.* **125** pp. 5–16, 4 figs. Paris, 1957.

A detailed account is given of field and laboratory observations in France showing that *Tiphia morio* F. is a parasite of *Amphimallon majalis* (Razoum.) and the manner in which the females of this Scoliid enter the soil in spring, paralyse the larvae of the Melolonthid and deposit their eggs in the intersegmental folds. The parasite larvae hatch in about a month and feed externally on the host, which carries them about as it periodically resumes activity. Examination of a colony of *A. majalis* in May showed that all parasitised individuals were still in the larval stage, though unparasitised ones had reached the prepupal or pupal stage.

Schaerffenberg (B.). *Beauveria bassiana* (**Vuill.**) **Link als Parasit des Kartoffelkäfers** (*Leptinotarsa decemlineata* **Say**). [*B. bassiana* as a Parasite of *L. decemlineata*.]—*Anz. Schädlingsk.* **30** no. 5 pp. 69–74, 2 graphs, 11 refs. Berlin, 1957.

With a view to experiments on the effectiveness of the entomogenous fungus, *Beauveria bassiana*, against *Leptinotarsa decemlineata* (Say), a method of producing the spores in large quantities was sought. The usual culture media [*cf. R.A.E.*, A **39** 439] proved insufficiently productive, but a high yield was obtained from a medium containing 15 per cent. malt extract and 3 per cent. meat peptone. The method of culturing is described. A saturated atmosphere is essential for sporulation, but temperature is less important, though development was more rapid at 21–30°C. [69·8–86°F.] than at higher or lower temperatures.

In laboratory tests at 22–24°C. [71·6–75·2°F.] and 65–70 per cent. relative humidity, dusts were applied to larvae on potato leaves. A dust consisting of the undiluted spores killed 23, 54 and 100 per cent. of fourth-instar larvae in 7, 10 and 15 days, respectively, and was even more rapid in

action against second- and third-instar individuals, complete kill resulting in five days. A dust consisting of 2 per cent. of the spores in talc was about as effective, giving 28, 61 and 100 per cent. mortality of fourth-instar larvae in 7, 10 and 14 days, respectively, in the author's tests and approximately complete kill in 16 days in one carried out by another worker. Temperature and humidity were found to have little effect on the initial infection, but a saturated atmosphere is required for the fungus mycelium to break through to the surface of the insect, so that other insects become infected naturally. This is of little importance, however, if a dust is applied. The spores are able to infect the insect through the spiracles and directly through the integument, as well as when ingested with food. Thus, topical application of spore dust to isolated larvae of *L. decemlineata* lying on their backs, so that it did not come into contact with their mouth-parts, invariably resulted in infection and death. When adults were dusted, the percentage mortality reached 30, 86 and 100 in 14, 30 and 36 days, respectively. There were no external symptoms of infection, and the beetles behaved normally until shortly before death. This greater resistance to the fungus is probably due to the thicker integument of the adults, as compared with the larvae. The appearance of the reproductive mycelium on the cadavers occurred 24–48 hours after death for larvae, but only after 48–60 hours for adults.

Field experiments with the 2 per cent. dust applied at the rate of 100 mg. spores per sq. metre were carried out on potato at Graz, Austria, in 1953 and at Cologne and Stuttgart, Germany, in 1954. At Graz, the dust was applied in favourable conditions in mid-August, when the second-generation larvae were in the fourth instar and almost ready to pupate. Within three weeks, 90·7 per cent. of the larvae, prepupae and pupae were killed by the fungus, and the few third-instar larvae present all died in the first week. At Cologne, the dust was applied in late June, when the larvae of the first generation were nearly all in the fourth instar; 80 per cent. of the larvae became infected within the first four days, the percentage mortality reached 96·4 in 19 days, and more than 50 per cent. of the pupae appeared to be infected. At Stuttgart, where the plot was only lightly infested, the dust was applied in mid-August, also against fourth-instar larvae; 68·8 per cent. of them were infected after a week, and 63 per cent. were dead after a fortnight and 80·9 per cent. after 23 days, the remainder pupating normally.

It is concluded that the failure of the fungus in previous experiments against *L. decemlineata* and other insects was due to a lack of virulence rather than to resistance of the insects, and it is considered essential for virulence that entomogenous fungi should be cultured on a protein medium.

Papers noticed by Title only.

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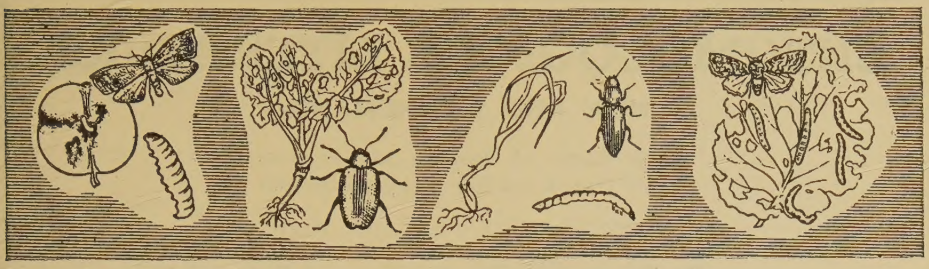

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CONTENTS.

[*Continued on p. iv of cover*

CONTENTS—*cont.*

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